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WADDELL CREEK

THE ENVIRONMENT AROUND BIG BASIN

THE ENVIRONMENTAL STUDIES PROGRAM
AT THE UNIVERSITY OF CALIFORNIA, SANTA CRUZ
in cooperation with
THE SEMPERVIRENS FUND

We share in dedicating this report to:

George Collins ~ the beauty of wild and natural places from our Santa Cruz Mountains to Alaska remains for us today because of his tireless work;

and to

Tony Look ~ he is as much a part of the Big Basin environment as the biggest redwood tree.

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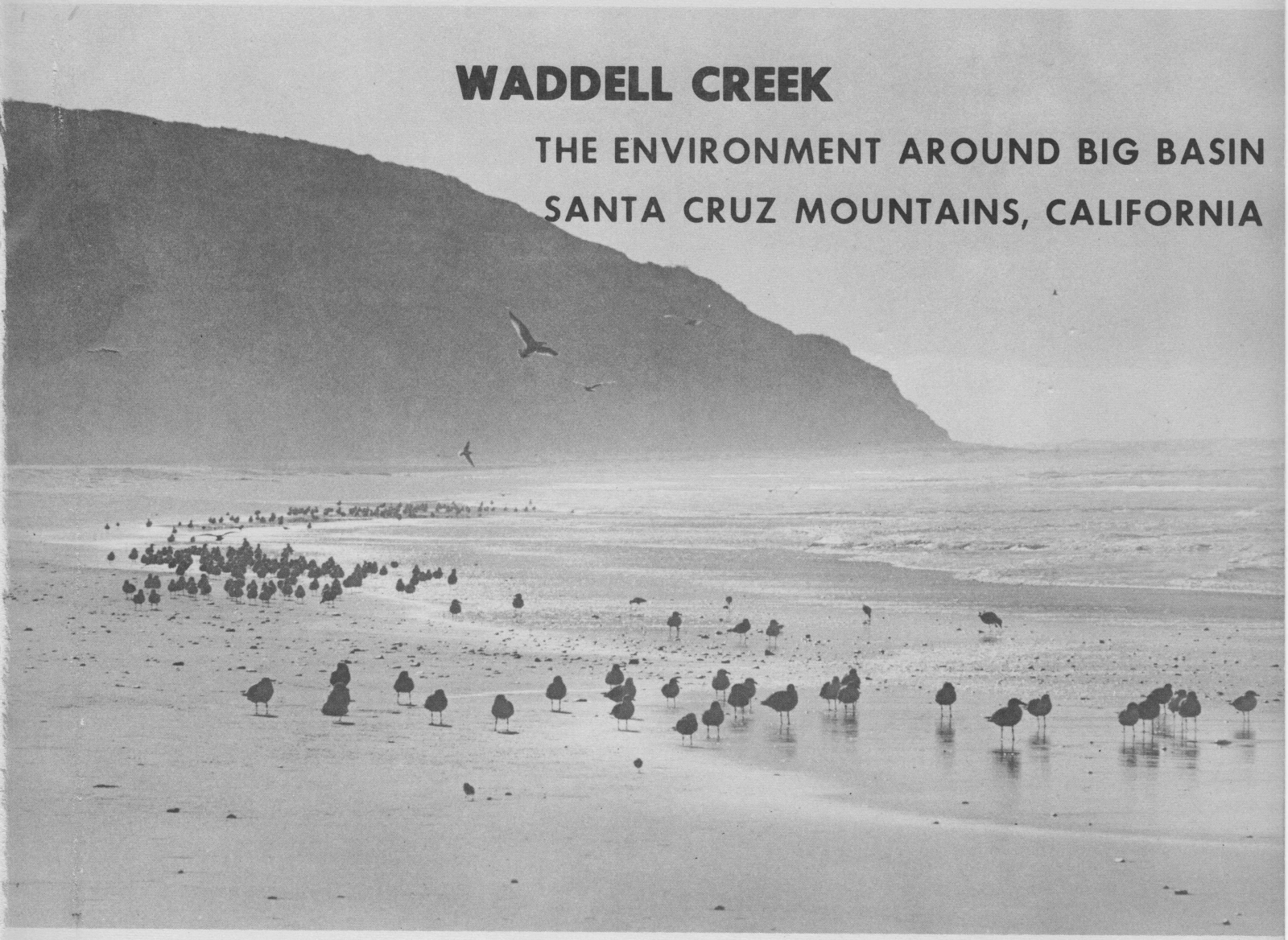
WADDELL CREEK

THE ENVIRONMENT AROUND BIG BASIN
SANTA CRUZ MOUNTAINS, CALIFORNIA



A Cooperative Effort
of the Sempervirens Fund
and the Environmental Studies Office, UC Santa Cruz
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EDITORS: BARRY HECHT
BARBARA RUSMORE

AUTHORS:
VIRGINIA WOLF
ROBERT STUART
STEVEN SPENCER
BARBARA RUSMORE
DANA ROBERTS
CYNTHIA REMEDIOS
CHRISTINE MORI
LAWRENCE KIRKENDALL
TODD KEELER
BARRY HECHT
PAUL BOYER
JOHN ASHBAUGH
YOEL ALON
DAVID ACUFF

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PREFACE

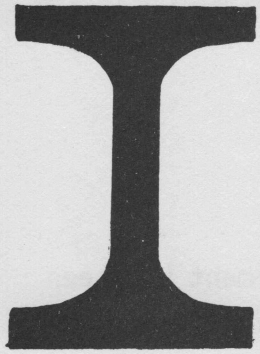
During the past few years, the California park environment has been the focus of sympathetic yet critical review. By now, it is generally felt that a thorough knowledge of the ecology and landscape is necessary for maintaining the quality of the park environment. The visitor especially appreciates this information as it is reflected in the interpretative program and in the improved design of the park's facilities.

With these objectives in mind, the Sempervirens Fund requested that the Environmental Studies Office at the University of California, Santa Cruz, study the Waddell Creek drainage as a step in planning for the acquisition program of Big Basin Redwood State Park. The Fund charged an interdisciplinary class of 12 undergraduate students with gathering and analyzing the environmental data pertinent to the expansion of the park. This report presents the results of our research during the first four months of 1972.

Both the field research and this report turned out to be very much of a group effort. The project team worked smoothly together, and we freely called upon one another to aid in the field work. Each chapter or section

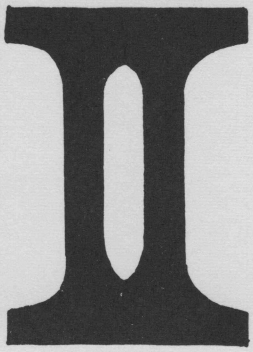
of the report was jointly written by several members of the class, who often collaborated on the illustrations as well. Every person on the project team contributed in real measure to the research and the writing, and thus fully enjoys the status of co-author. In addition, Barbara Rusmore, Dana Roberts, and Cynthia Remedios were instrumental in revising the report, and proudly assumed much of the task of preparing it for publication.

Although the data deals with the environment, the anticipated problems during transition to park ownership derive primarily from human use of the land. In light of our objectives, therefore, we elected to organize the chapters of this report to emphasize man's changing role in the landscape and the attendant management problems.



Part I is a description and analysis of the changing environment of the Waddell presented from three perspectives. The three sections are each composed of a pair of related chapters. In addition, Part I is introduced by a brief description of the appearance and image of the Waddell and the present uses of the land. The first section describes the dynamic, constantly changing natural environment, first with an historical discussion and then with a chapter considering the physical processes of change. The middle section focuses on the visitor's enjoyment of the parkscape. The initial chapter of this section, emphasizing notable features and contrasts, details some of the more impressive forms, patterns, and communities molded by the natural processes. Microstudies, the companion chapter, provided an opportunity to express personal impressions of six smaller parts of the Waddell that particularly moved us. The final section attempts to anticipate a number of land management problems. These are analyzed according to geologic, hydrologic, and biologic systems in the Impacts chapter. Here, we try to approach the changing management patterns in a conventional ecological framework, encouraging comparison with other areas. In the complementary chapter on Conflicting Uses, specific management problems are considered in the hopes that this format may prove more convenient to the people who will manage the land. The conclusion to Part I focuses on the fundamental unity of

the Waddell and its potential importance in the evolving patterns of growth in coastal Central California.



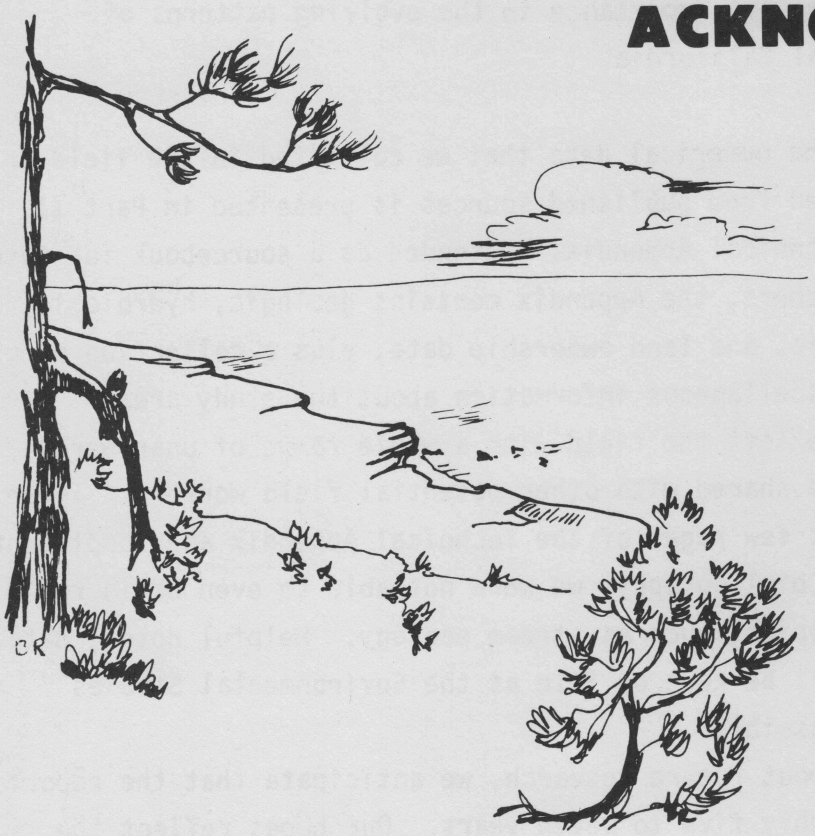
The numerical data that we collected in the field or compiled from published sources is presented in Part II, the Technical Appendix. Intended as a sourcebook for future researchers, the Appendix contains geologic, hydrologic, biologic, and land ownership data, plus a collection of useful miscellaneous information about the study area.

We left the field with a whole range of unanswered questions that should be shared with other potential field workers. These are detailed in the last few pages of the Technical Appendix and supplemented with a comprehensive bibliography; we were not able to even begin research on a number of topics, such as stream ecology. Helpful notes, data, graphics, and photos will be kept on file at the Environmental Studies Office for as long as possible.

Being optimistic about future research, we anticipate that the report will be outdated in roughly five to seven years. Our hopes reflect the great growth during the past five years in the environmental sciences and in the public's enthusiasm for incorporating the added information into the planning process. We hope that this trend continues, aided perhaps by long-range, systematic research in a conserved Waddell basin.

Barry Hecht
Project Instructor
February, 1973

ACKNOWLEDGMENTS



The Waddell Creek study involved quite a bit of group research from the beginning of the project. Members of the class are very grateful to those who shared the rewards and suffered through the inconveniences of this approach.

This study was a student field project within the Environmental Studies Office, U.C. Santa Cruz, and was directed by Dr. Ray Collett. Benjamin Shaine, Carolyn Knotts, and Charles Kent of the office staff joined Dr. Collett, in providing the sympathetic criticisms, ideas, and assistance that are vital to any successful field investigation.

Our research depended on the open cooperation of local residents, such as Mr. and Mrs. Charles McLean (Rancho del Oso) and Curtis B. Mitchell (State Park System), who provided entry and assisted where possible. Homer ("Bud") and Frank ("Lud") McCrary repeatedly helped us with detailed information and encouragement, contributing to virtually every chapter. Members of the School of the Earth community extended a most cordial hospi-

tality and friendship.

We gained both competence and perspective from concerned experts who shared with us their skills and professional experience in the Waddell. Our gratitude extends especially to Charles Beutler (Soil Conservation Service, Watsonville), Roger Luckenbach (Geography, U.C. Berkeley), Denzil and Jenny Verardo and Bill Beat (Big Basin staff), Michael Bronson (Zoology, U.C. Berkeley), Dr. Jean Langenheim (Biology, U.C.S.C.), Dr. Robert Twiss (Landscape Architecture, U.C. Berkeley), and Henry Baker (Santa Cruz County Planning Department).

Other researchers freely shared their observations and field notes with us. We are particularly grateful to Koichi Kobayashi (Landscape Architecture, U.C. Berkeley) for his repeated and selfless assistance. Gerald Weber (Earth Sciences, U.C.S.C.) provided the field materials of a reconnaissance study. Viola Anderson offered the use of the Santa Cruz Bird Club records; John Wehausen and Henry ("Woody") Elliott of Berkeley extended their comparable study in the Point Reyes area.

We also owe a debt of gratitude to the many individuals who helped expedite our study, some of whom deserve special mention. Carolyn Knotts, Diana Rogers, Jean Kondo, and Anne Drescher assisted with typing manuscripts. Stanley Stevens (U.C.S.C. Map Librarian) found and lent us numerous resource maps and aerial photographs. Dr. Theodore Oberlander (Geography, U.C. Berkeley) arranged the loan of most of our field equipment, while Geraldine Powell (U.C.S.C.) opened her laboratories for our water quality analyses. Paul Tara and Sheila Stuart led us through the recent property records in the Santa Cruz County Assessor's Office. Charles Kent and Steven Smith joined team members with camera work and in the dark room. Helen Sherra, Jane Williams, and Loretta Haynes helped expedite our sometimes unusual requests through the University administration,

At each step of the program, we were aided by faculty, residents of the area, and friends. We would especially like to acknowledge the timely and thorough review of the report drafts by the McLean and McCrary families, by Curtis Mitchell, by Hal Morris of Santa Cruz, and by sponsor Claude A. ("Tony") Look. C.T. Roberts of Los Gatos aided immeasurably in the thankless task of editing, as did Fredric Wiebe and James Gaw of Santa Cruz.

Roger Luckenbach and Ray Collett revised and reorganized the lists of plants and animals in the Technical Appendix. The large photographs which afford a mood of transition between sections of this report were graciously loaned by Alexander Lowry. Any remaining errors remain, of course, the responsibility of the members of the project, most of whom will continue their research in the Waddell during the first months of 1973.

Throughout this study, we have been enthusiastically guided and sponsored by the Sempervirens Fund. Jane Y. McKenzie graciously and generously enabled publication of this report. Special thanks go to Tony Look, Doris Leonard, and George Collins for their interest and encouragement.

TABLE OF CONTENTS

Preface i

Acknowledgments iv

Table of Contents vii

Part I: Report

Introduction 3-5

Persistent Change in the Landscape

History 6-13

Geologic Change
Biologic Evolution
Earlier Human Habitation

Processes 14-28

Geologic Processes
Hydrologic Processes
Biologic Processes

The Visitor's Parkscape

Features and Contrasts in the Landscape 29-43

Visual Image and Vistas
Water Features
Water Contrasts
Features of Rocks and Soils
Contrasts of Rocks, Soils, and Landforms
Life Features
Life Contrasts

Microstudies 44-67

Eagle Rock Area
North McAbee Creek Area
Henry Creek Area
East Waddell Gorge Area
Lower Last Chance Road
Lower Waddell Creek Valley

Problems of Land Management

Man's Impact on the Land 68-80

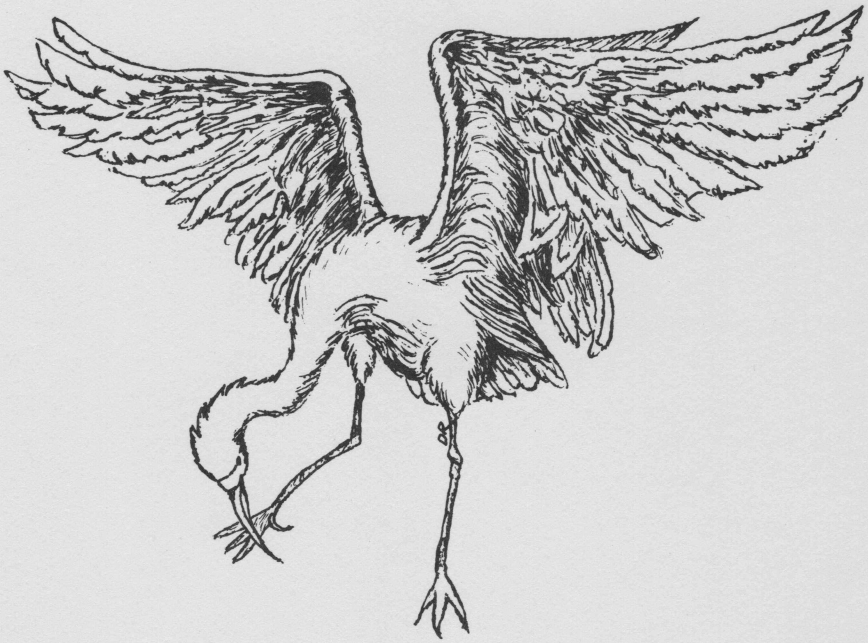
Impacts on Geologic Systems
Impacts on Hydrologic Systems
Impacts on Biologic Systems

Conflicting Uses 81-94

Selected Ecological Management Problems
Conflicts of Use Intensity
Boundary Conflicts in Park Design

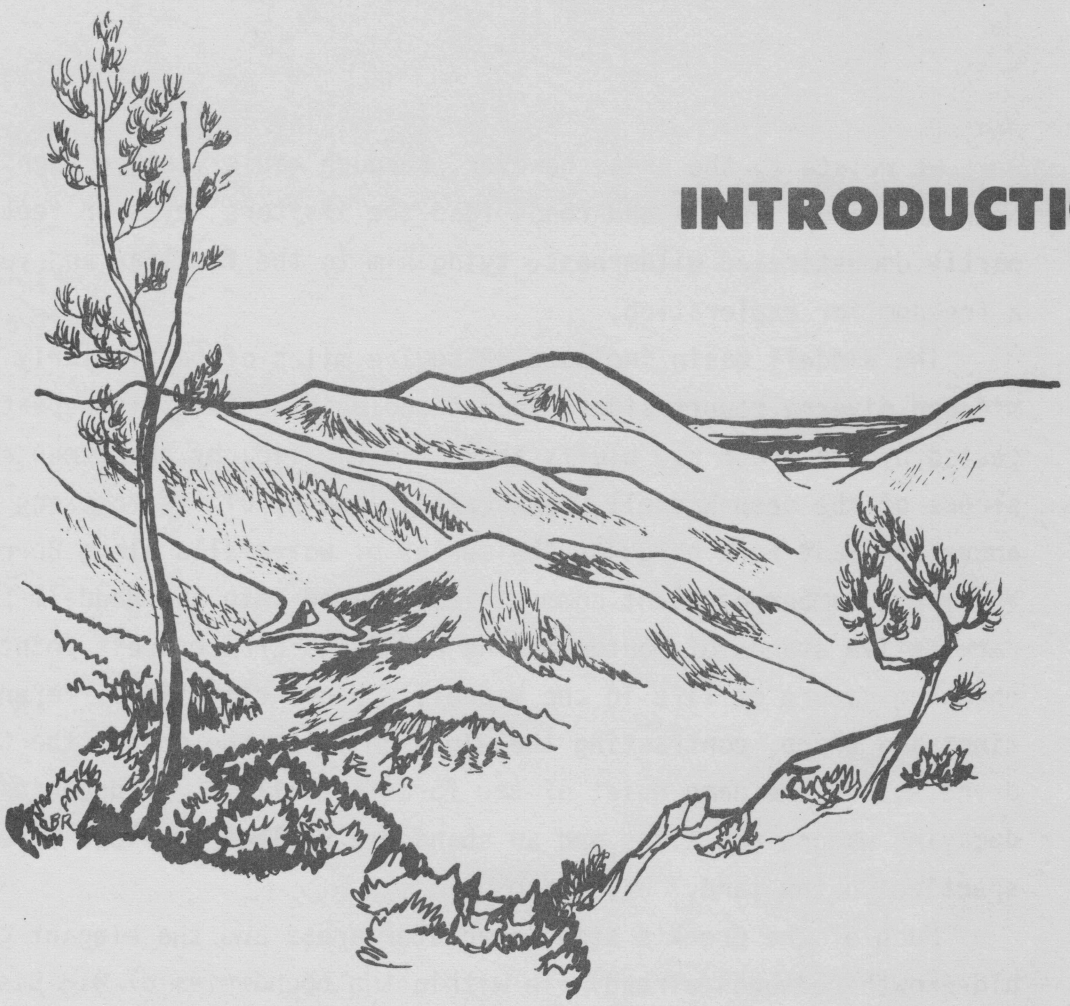
Conclusion 95-98

Part II: Technical Appendix



PART I REPORT

INTRODUCTION



The Waddell Creek basin lies in the center of the largest unurbanized portion of the Peninsula area of the San Francisco Bay Region. Most parts of the drainage, including Big Basin Redwoods State Park, are an hour's drive from the nearest cities of Palo Alto, San Jose and Santa Cruz. Despite continuing growth and development near the Bay (Fig. 1), the Waddell is still relatively remote and open. To many of its one million visitors per year, the Big Basin country of the upper watershed is a public wild land to be explored and enjoyed with a traditional full day's visit.

The texture of the landscape emphasizes its undisturbed appearance. The twisting natural drainages, contorted by complicated patterns of erosion, give a maze-like quality to the few orienting vistas. Impenetrable brush on the ridgetops fences off the horizon, lending a wild quality to the view, and leading the eyes back toward the quieter valleys, where redwoods and Douglas firs dominate the enclosing forests. The trees carpet and soften the rugged lower slopes. There is a refreshing and consistent naturalness to this green mosaic.

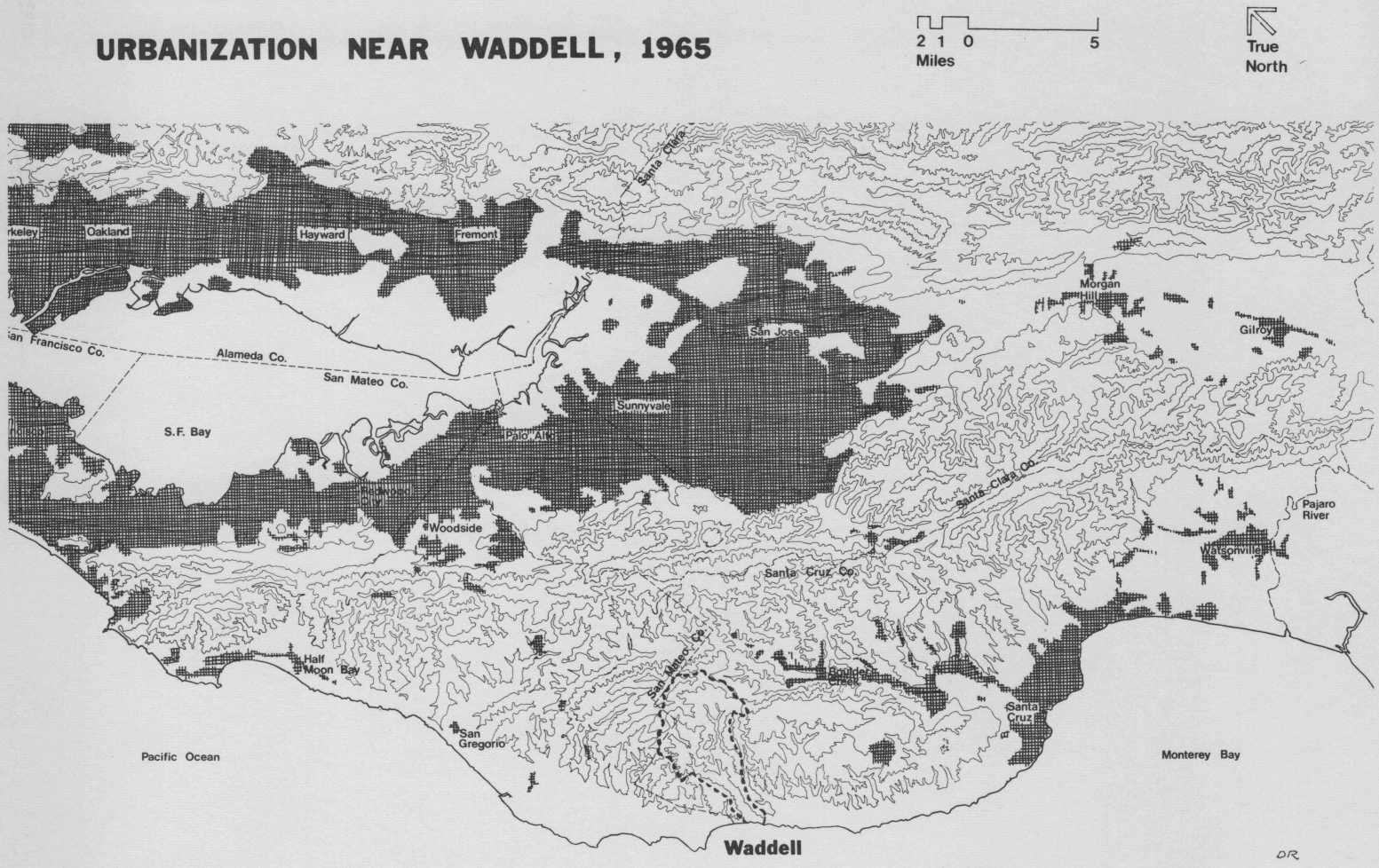
We relate to the area, however, through man's visible signs dispersed over the land. Trails and roads lead the visitors' eyes or feet through partly domesticated wilderness, tying him to the familiar and yet allowing a freedom for exploration.

The Waddell basin includes 22 square miles of particularly rich, dynamic and diverse countryside. Recent geologic activity is repeatedly suggested by the fresh raw bluffs above the Pacific, by the steep and sliding slopes of the deep Waddell Creek valley, and by cliffs towering 1000 feet above the East Fork gorge or the series of waterfalls along Berry Creek. The large number of plant communities crowded into the Waddell plus the rare native stands of Monterey pine and Santa Cruz cypress point toward the changing nature of life in the Waddell. Micro-climatic differences are distinct and sharp, contrasting the windy chill on the coast, the Chalk's dusty dryness, and the damp quiet of the forested valleys. Hidden in the trees, decaying wagons and kilns and an abandoned railbed reflect an earlier perspective on the land.

Much of the Creek's steep headwater areas and the elegant groves of old-growth redwoods already lie within the boundaries of Big Basin Redwood State Park, but the full promise of this dynamic landscape can be realized only with access to the adjoining lands and to the coast (see map foldout). The park's approved Master Plan recognizes this promise and calls for eventual purchase of the entire drainage. Private organizations such as the Sempervirens Fund and Save the Redwoods League are now joining with the State Park staff in an acquisition program to implement this plan.

Park expansion will compete with a local surge in real estate sales and activity. During the past four years, three areas in or adjacent to the drainage have been subdivided into rural "estates" and sold largely as second home sites. The number of new lots doubles each year (see Technical Appendix), constantly involving more people with more plans for the land. In these three areas, including the scenic East Fork gorge, acquisition by the park has become more difficult and complex. Thus subdivision needs to be considered as a major on-going process of landscape change affecting the planning and management of the park.

The remainder of the watershed includes working ranches, various types of tree farms, and miscellaneous private holdings. In some cases, a long

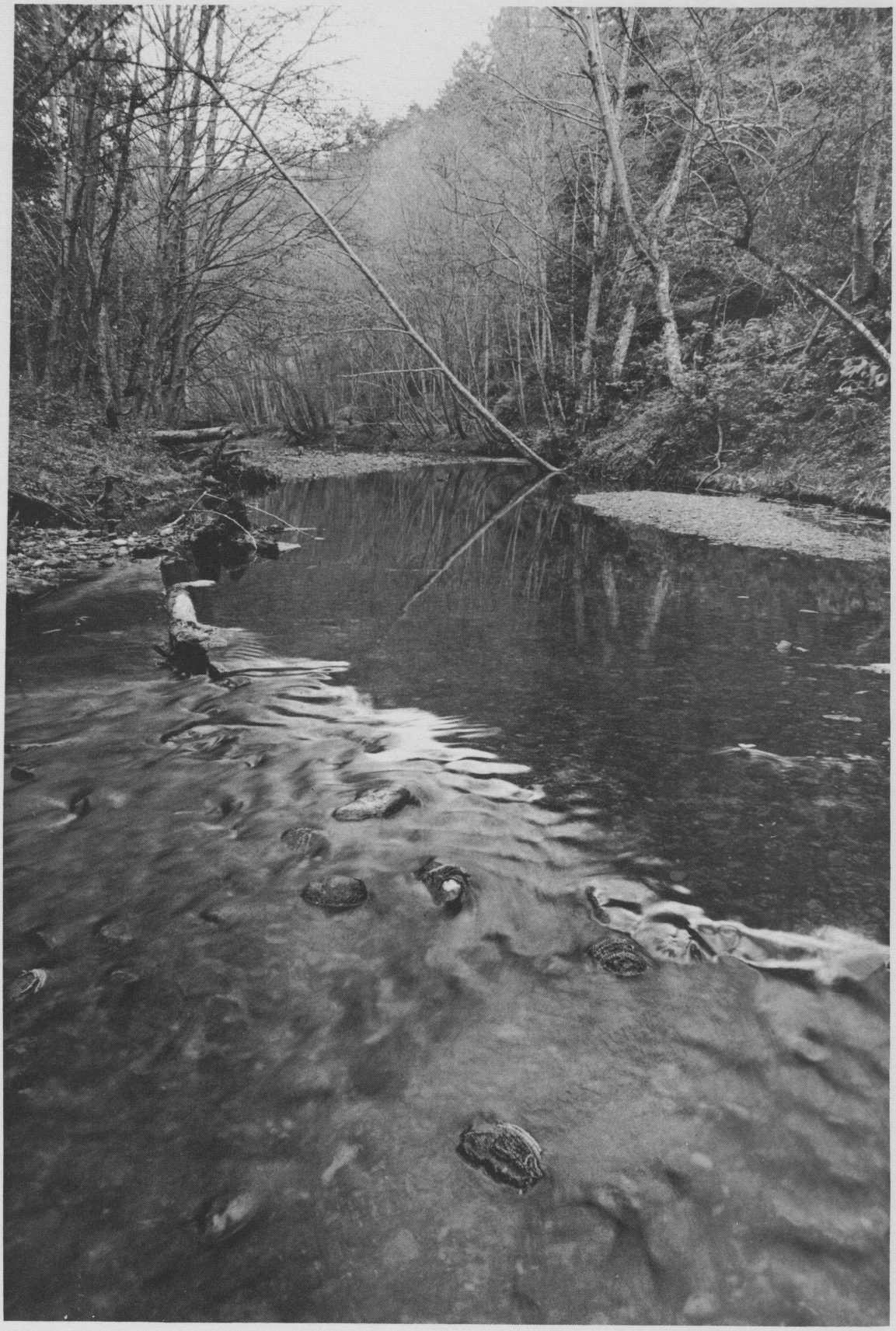


Adapted and Revised from Patri , Streatfield, Ingmire, 1970

Revisions from aerial photographs and topographic maps (1:125,000) published by ABAG, and reconnaissance

Fig. 1 The Waddell occupies an important position as a wild land on the fringes of the San Francisco Bay urban area.

and silent tradition of careful husbandry comes with the title to the land. Current county planning policy calls for open space uses over virtually the entire basin. The challenge now facing the park staff is to maintain or enhance the present environmental quality levels and open space values while providing for the growing number of visitors, now in excess of one million per year. Public support for a management that emphasizes sensitivity, ingenuity, and a thorough understanding of the Waddell can only aid in achieving this goal.



PERSISTENT CHANGE IN THE LANDSCAPE

HISTORY

The story of the Waddell begins long before man made it his home. Its origins are rooted in the evolution of the west coast of North America. The story, as it is now known, is one of long, relentless change.

The land and its life have been and continue to be a dynamic system, each interacting with the other, creating and responding to new environmental conditions. The pace of change has been relatively slow by man's time scale. Devastating catastrophes, such as floods, fire, or drought, locally shaped the landscape. But the natural cycles of uplift, erosion, sedimentation, and biotic succession and migration have long proceeded at a rate that allowed the system to maintain its evolving equilibrium.

Man has recently entered into this dynamic system. His activities have altered the landscape and will probably change the overall nature of evolution of the Waddell.

GEOLOGIC CHANGE

The landforms of the Waddell Creek valley and Big Basin are currently being molded by a rapidly-evolving interplay of uplift and erosion. They reflect the latest episode of deformation and denudation that have affected the Coast Ranges of California through tens of millions of years.

Much of the more recent uplift took place along the Ben Lomond Fault, which trends across the central part of the drainage. The coast side of the fault has been raised several thousand feet during geologic time, elevating Eagle Rock, Pine Mountain, and Mount McAbee above Big Basin. The East Waddell gorge has been cut deeply into the uplifted rock over an extended period of time. Movement along the fault periodically dammed or diverted the streams flowing across it toward the coast. One filled backwater has developed into the current Big Basin.

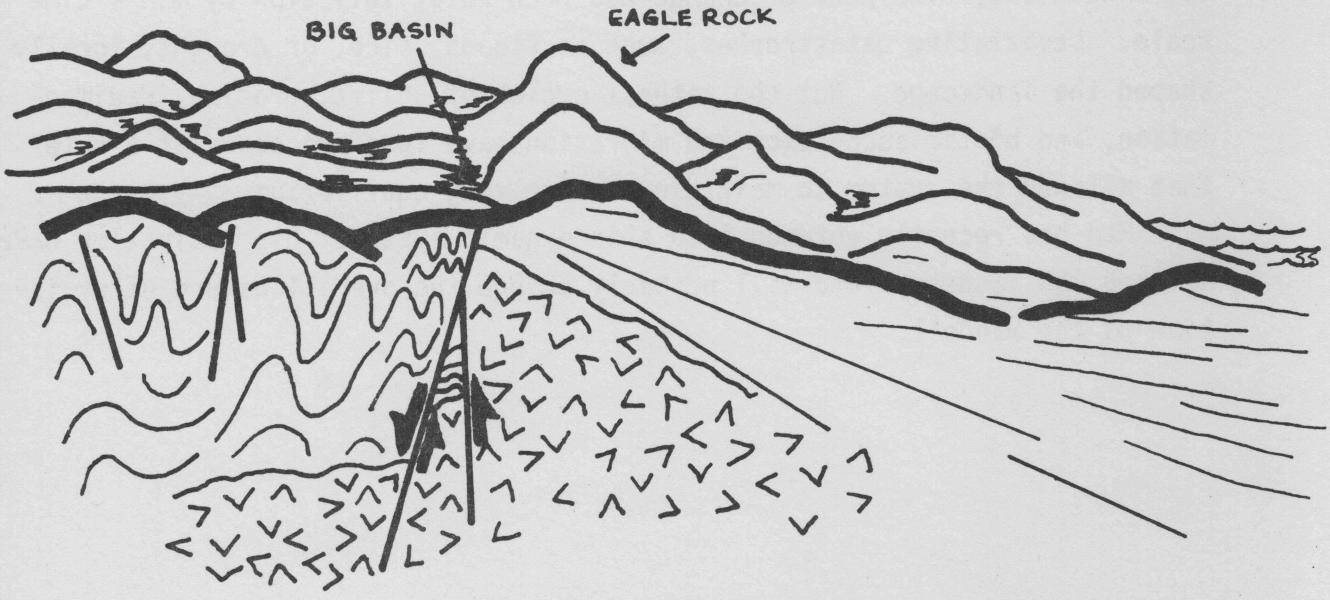
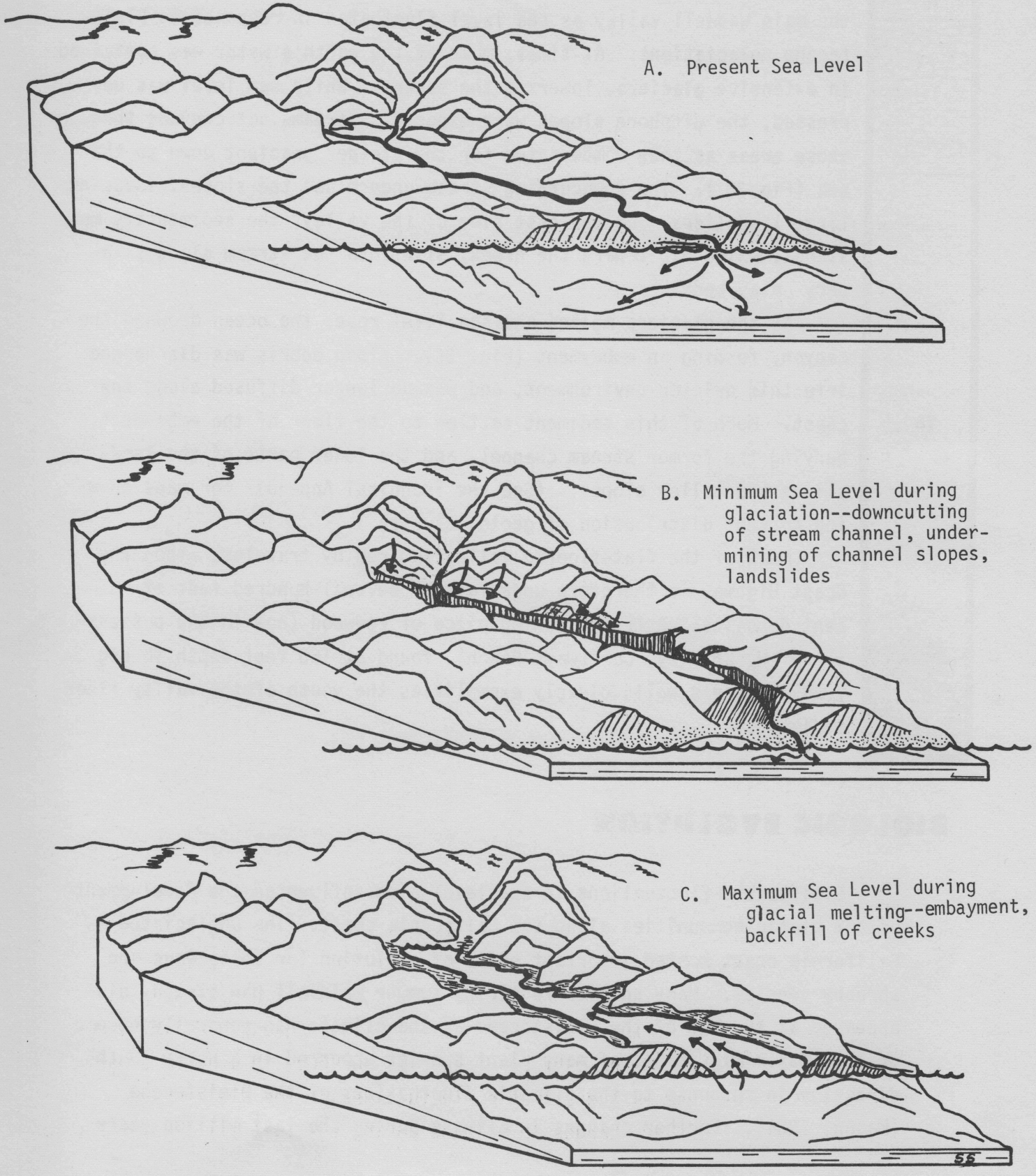
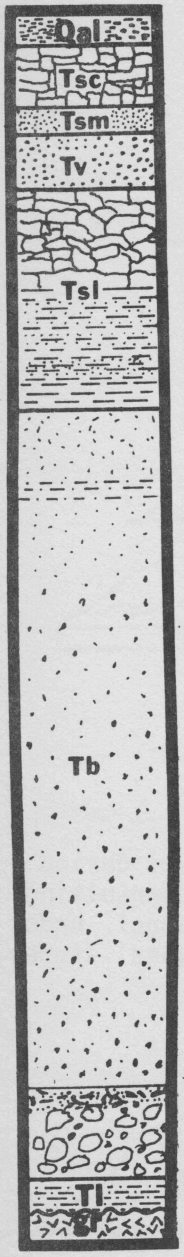


Fig. 2 The Ben Lomond Fault is a major force in the development of the park landforms, uplifting peaks such as Eagle Rock and creating basins on the downthrown side. Geologic units are described in the Technical Appendix.

Fig. 3 The Effect of Fluctuating Sea Level on Erosion and Deposition in the Valley





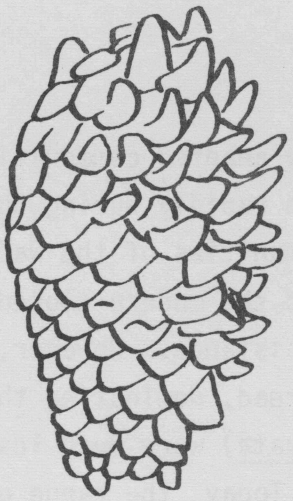
An entirely different set of processes has acted more recently on the main Waddell valley as sea level fluctuated in response to Pleistocene glaciations. At times, much of the earth's water was contained in extensive glaciers, lowering the oceans. While sea level was depressed, the offshore slopes were exposed. Streams cut canyons through these areas as they compensated for the steeper gradient down to the sea (Fig.3B). The downcutting stream undermined the slopes, inducing large landslides. On the east side of the valley, the sedimentary mudstones, which dip toward the creek, slid into the stream along slippery clay beds.

As the glaciers melted and sea level rose, the ocean drowned the canyon, forming an embayment (Fig. 3C). Flood debris was discharged into this quieter environment, and was no longer diffused along the coast. Much of this sediment settled to the floor of the embayment, burying the former stream channel, and the lower parts of the landslides and valley slopes. (See the Technical Appendix for maps showing current distribution of geologic units.)

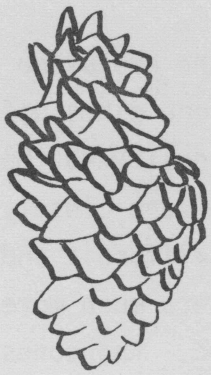
Much of the flat-floored valley admired by travelers along the Coast Highway is therefore underlain by several hundred feet of recent deposits. A fresh-looking piece of redwood (now in the possession of H. Bradley, Coastways Ranch), found at 165 feet depth in Big Creek Lumber's well, clearly exemplifies the youth of the valley floor sediments.

BIOLOGIC EVOLUTION

Pleistocene fluctuations in sea level also influenced the development of the biotic communities along the California coast. The unglaciated California coast hosted important sites of evolution for herbaceous and shrubby species. Many species requiring summer rainfall had already disappeared at the end of the Pleistocene as the climate had generally become drier. Major migrations of many plant species occurred in a north-south direction in response to the climatic fluctuations of the Pleistocene (Mason, 1954). Further changes in climate during the last million years

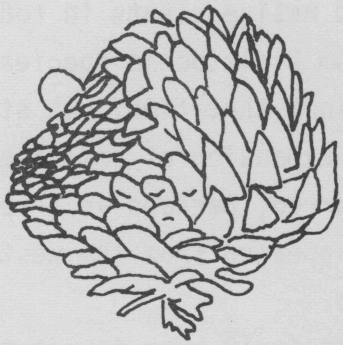


Pinus liguiformis



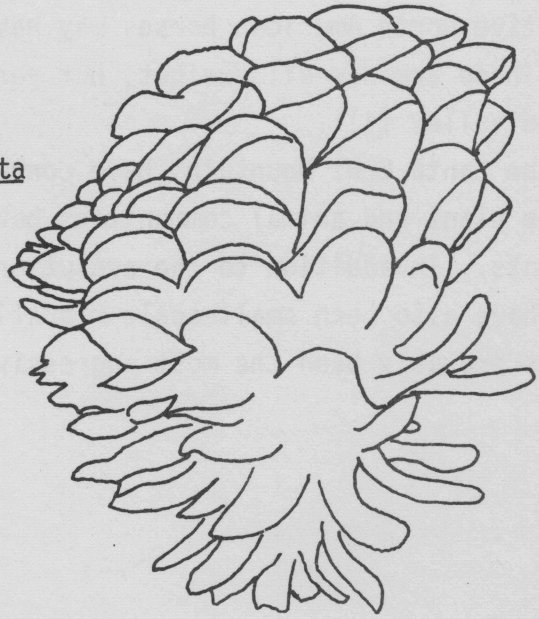
Pinus Masoni

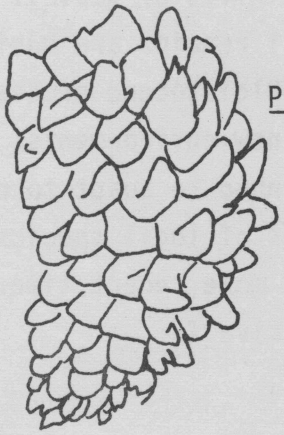
Pinus remorata



Pinus muricata

Pinus radiata





Pinus attenuata

Fig. 4. Pleistocene and Recent Closed-Cone Pines Showing Variation Over Time (After H. Mason)

have encouraged the evolution of narrowly adapted communities.

The closed-cone pines differentiated rapidly during the Pleistocene, lending added diversity to the plant communities of the Waddell. The forests of that time were closely related to the modern closed-cone pine forests of coastal California and off-shore islands. However, Monterey pines (Pinus radiata) were much more widely spread, dominating the pine forests of the Pleistocene. Knobcones (P. attenuata) were much less common, but were beginning their current expansion. Today, the range of the Bishop pine (P. muricata) is still expanding, while the distribution of the Monterey pine is shrinking (Mason, 1935). The Waddell contains a large portion of one of the four remaining natural stands in the world.

Most native plants in today's central California vegetation are derived from Pleistocene species. They have become morphologically differentiated since that time, but still occupy essentially the same ecological niches. Expansion of some species, such as Bishop pine and Douglas fir, have occurred, perhaps as a response to climatic changes. Other species have disappeared from the west coast of North America but persist in Asia or Mexico.

The grizzly bear is not the only large mammal of the recent geologic past that is no longer found in the area. During the Pleistocene, the northern elephant, Dire wolf, and native North American horses may have roamed the hills of Waddell Creek. These are now all extinct, but perhaps some fossil remains are buried in the valley fill.

Post-Pleistocene processes in the Santa Cruz Mountains have continued to create new environments; thus, the plant and animal communities have also continued to adapt to new habitats. In addition to the evolution and extinctions of local species, there have also been small-scale migrations throughout more recent time. Man has probably been the most aggressive of the new arrivals.

EARLIER HUMAN HABITATION

The recorded history of the Waddell begins with the Costanoan Indians, who inhabited the lower reaches of the watershed. Their diet was based largely on the fruit of the California buckeye (Dr. L.B. Gordon, oral communication) and fish (Patri, Streatfield, and Ingmire, 1970). Their simple lifestyle limited the ways in which they modified the landscape. They did, however, burn the canyon grasslands to keep out the brush, which would otherwise have impeded travel, hunting, acorn gathering, and the growth of seed bearing annuals.

The Spanish were the next to pass through the area. In 1769, the Portola expedition, in search of Monterey Bay, failed to recognize it as they passed. Believing themselves too far south, they pushed on northwards, following the coastline toward San Francisco.

Father Crespi, the Franciscan missionary on the expedition, kept a diary during the long journey...

"'Friday October 20, 1769. In order to leave this place (perhaps on upper Scott Creek)...We traveled for a long space on the ridge of a chain of rough broken hills which drop to the sea, and halted on the same beach at the mouth of an arroyo or valley about a league from where we started. In this short stretch the coast runs northwest by north. The valley is open to the north-north-westward, and it enters the land in the same direction something like a league...This spot or arroyo I have named Valley of San Luis Beltran.

'Saturday, October 21. This day was set aside for the explorers to spend the day in reconnaissance, and to serve as rest for the sick, who do not feel any worse, although their improvement is slight...This afternoon and in the night a heavy rain fell, together with a strong wind from the south which stirred up a storm on the sea.

'Sunday, October 22. This day broke very cloudy and dark, with all the people wet and fatigued from loss of sleep for lack of tents, so that it was necessary to rest today and dry the clothes, our greatest anxiety being lest the poor sick persons with us might be harmed by the wetting. But exactly the contrary happened, and it seemed as though God had sent them health with the drenching, for to the surprise of everybody they be-

gan to improve, and in a short time were entirely recovered, thanks to God, to whom we attributed this special blessing. For this reason the valley was renamed La Salud' (now thought to be Waddell Creek)." (Meadows, 1950)

Less than a hundred years from the time Father Crespi offered his prayer of thanks, the walls of the valley were to resound with the sound of the woodsman's axe. William Waddell ran a successful lumbering operation in the valley until the time of his death in 1875. In 1913, Theodore Hoover purchased most of the parcels that now make up Rancho del Oso. A definitive history of Rancho del Oso has been compiled by his daughter, Mrs. Hulda McLean (McLean, 1971). During the first two years of this century, Boulder Creek loggers such as H.L. Middleton and Irving Bloom, announced intentions to log in the then remote Big Basin. The Sempervirens Club, under the chairmanship of Andrew P. Hill, arranged for legislative appropriation of funds to begin acquiring this first California State Park in 1902. Denzil and Jennifer Verardo of Big Basin are writing a full account of the history of the upper watershed areas, which will soon be available.

PROCESSES

Waddell Creek is a dynamic ecosystem. Land and life revolve in unending cycles of flux and flow, some invisible to the human eye and others readily perceived. Diurnal cycles are most readily observed, from dawn to dusk to the next dawn, from the silence of night to the chatter of activity of the day, again into silence. Reproductive cycles are of longer duration, usually annual or seasonal. Most plants store nutrients during the wet cool fall and winter and expend their energies to blossom and fruit during the warmer spring and summer. Some cycles proceed so slowly as to appear to be at a standstill. The physical processes of tectonic activity, the hydrologic cycles, erosion, flooding, and weathering, as well as the set of processes that mold coastal morphology are such cycles, slowly repeating events that shape the framework of the landscape.

GEOLOGIC PROCESSES

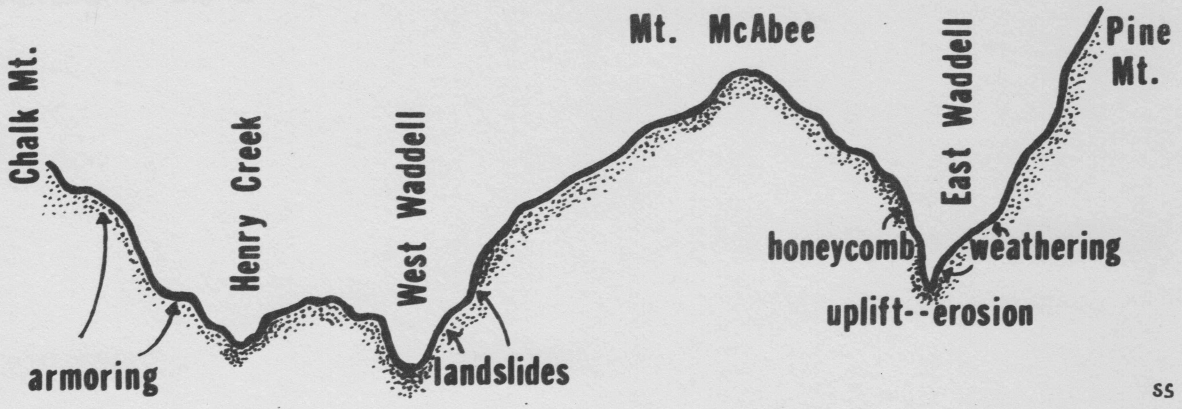


Fig. 5 This cross-section trends northwest through the Waddell watershed, indicating some of the earth processes that influence the landform. The physical processes shown are not limited to these areas alone, but are merely pinpointed here to give a perspective of their relationships to the mountain-valley system.

The East Waddell gorge is an excellent example of the work of seismic uplift and erosion. Uplift on the coastward side of the Ben Lomond Fault has been estimated to be 3,000 to 10,000 feet during the last 60 million years. The magnitude of uplift decreases towards the coast (Clark,1970; Brabb, 1970).

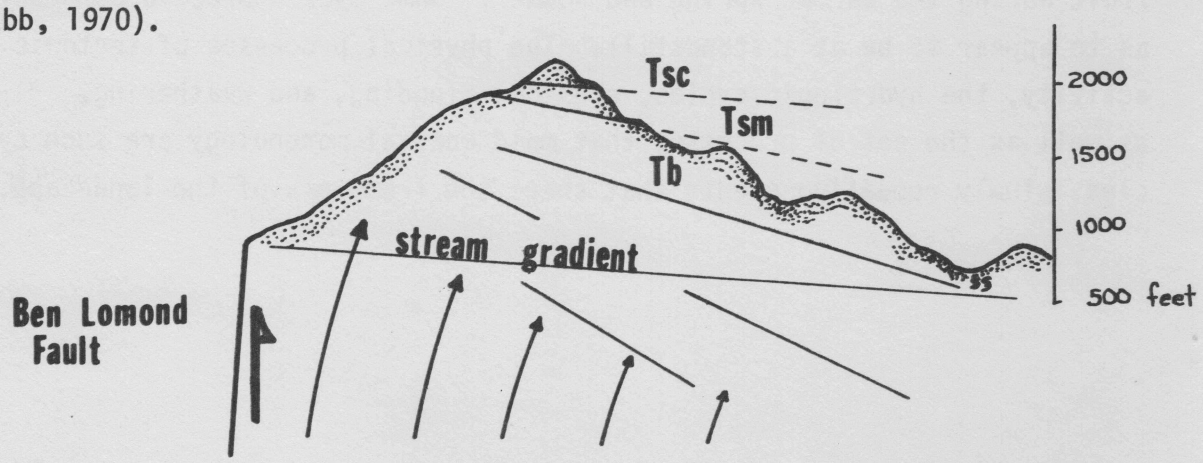


Fig. 6 Doglegged cross-section of Pine Mountain, as seen from East Waddell gorge. Dipping sediments show uplift and tilting of block on coastal side of Ben Lomond Fault. Oldest to youngest sediments are Tb: Butano sandstone; Tsm: Santa Margarita sandstone; and Tsc: Santa Cruz mudstone.

The sediments were originally deposited horizontally; steeper dips in older sedimentary beds correspond to longer periods of subjection to uplift, while younger formations have shallower dips. The relatively young Santa Margarita and Santa Cruz Formations thicken toward the coast, suggesting that they were deposited during a period of continuous tilting in the recent past. The stream continues to carve the gorge, with the greatest amount of cutting taking place nearest the fault.

Landsliding is among the most noticeable physical processes in the Waddell. Many of the older, extensive slides in the valley may date back to the several major drops in sea level (up to 300 or more feet) of the Pleistocene. Residents of the region repeatedly indicate that in recent times most of the downslope movement occurs during peak flooding. Landslides are concentrated on the east bank, since the oversteepened slopes on that side facilitate slippage along the bedding planes that dip towards the creek.

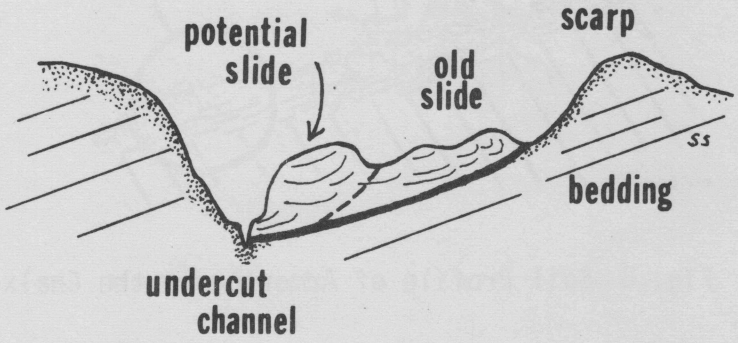


Fig. 7
Landslide Profile of West Waddell

Massive sliding frequently occurs in this sector of the Santa Cruz Mountains where a stream valley cutting through mudstone intersects a fault. Within the Waddell, this is common in the San Lorenzo Formation, where Waddell Creek intersects the Ben Lomond and Opal Creek Faults and along a number of smaller fractures.

The delicate soil of the Chalk ridges is protected by "armoring", a process that illustrates the diversity of soil formation in the Waddell. In the Chalks and in some other mudstone areas of the Waddell, wind and water remove finer rock particles and eventually leave a sheet of mudstone chunks on the surface of the soil. Usually, the steeper the slope, the larger the armoring pieces, since large pieces alone can resist the power of sheet erosion on steep slopes. Protection of the soil provided by the armoring makes plant growth possible.

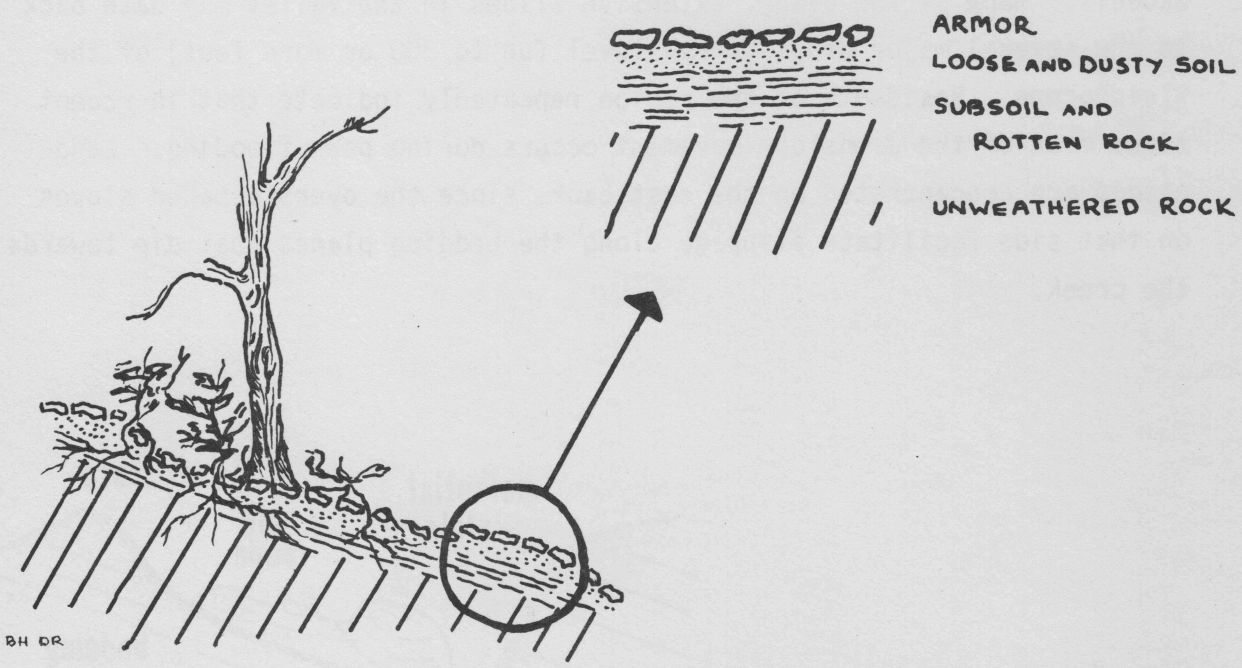


Fig. 8 Soil Profile of Armoring in the Chalks

Material eroded from the Basin slopes is carried into the creek and washed downstream, mainly at times of high flood. Much of the load of sediment originates from landslides. Erosion must be complemented by deposition, and the valleys and floodplains of the Waddell Creek attest to flowing water's ability to transport debris. Fires and the 1917 floods buried a substantial length of the rock bed of Opal Creek under a thick sheet of sand and gravel (Hulda McLean, personal communication). However, the flat terraces of Opal Creek and West Waddell are likely the products

of tectonic movements as well as torrential floods.

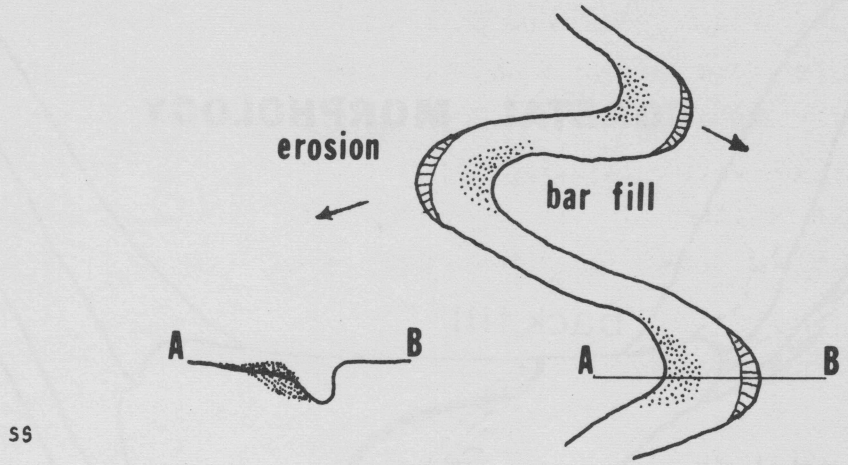


Fig. 9 Pattern of Stream Meandering, Showing Cutting and Filling (seen in the lower valley)

The Waddell has meandered away from its old channel during the past century or two (see Fig. 9). As the stream cut and eroded the outside of its bends, it depositied much of the eroded material on the inside of the next bend. The meandering increased to the extent that one of the protruding bends was cut off, forming an oxbow lake, which finally became a small fresh-water marsh slightly east of the mouth of the Waddell.

Coastal sand transport by the ocean wave front and by the winds is another of the fluctuating processes influencing the Waddell. A strip of small sand dunes and berms has developed along the beach, forcing the creek to empty at the extreme southern edge of the valley. Until recently, the creek emptied near the middle of the valley, although it ranged annually as far north as the rocky point at the edge of the valley (Hulda McLean, personal communication). A long sand ramp swept up from the beach to the present Big Creek millsite (H.L.McCrary, personal communication). The shift of millions of cubic yards of sand represents the everchanging nature of the beachlands environment.

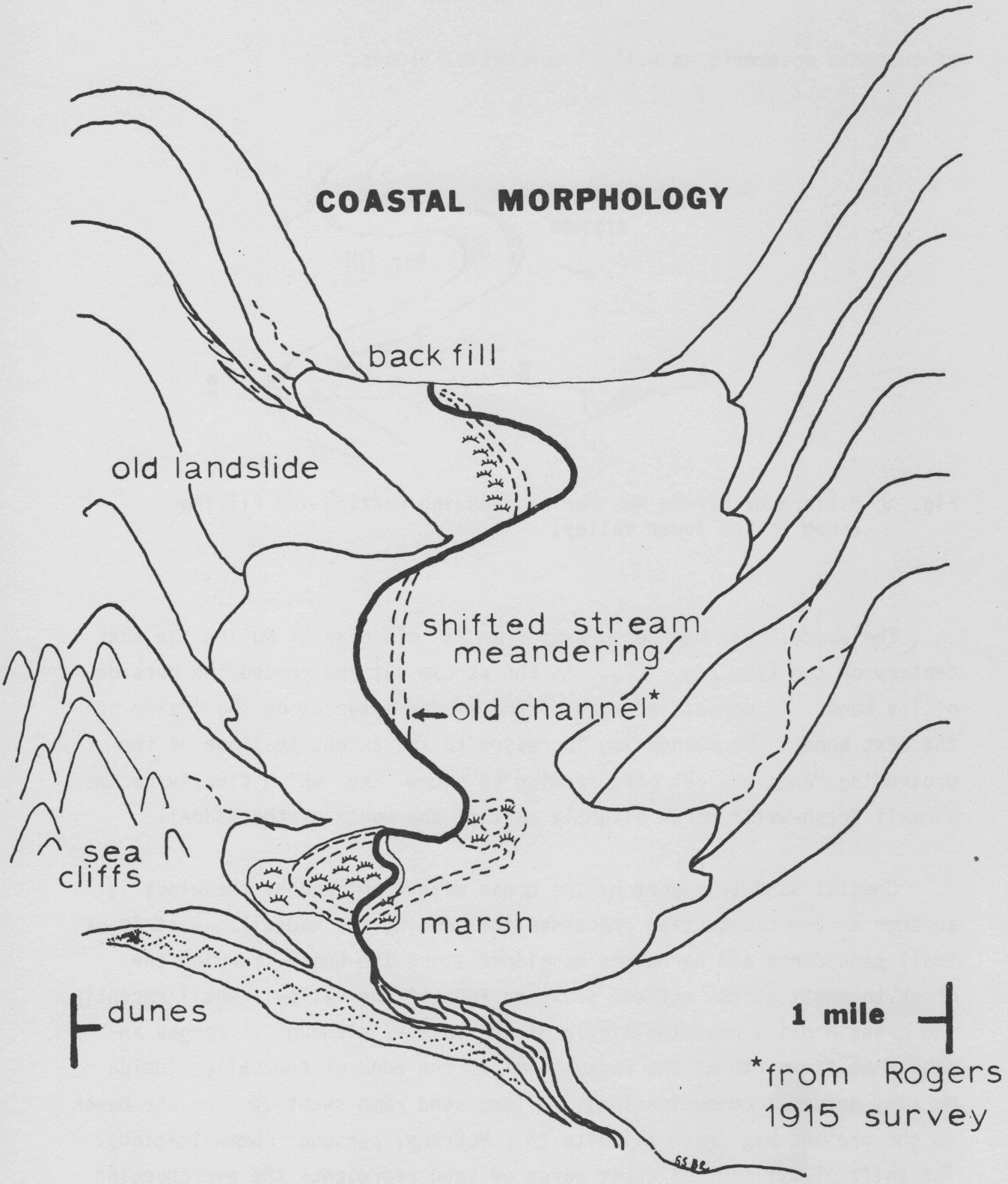


Fig. 10 Changes in Lower Valley and Coastal Area

HYDROLOGIC PROCESSES

In its general characteristics, Waddell Creek is typical of a majority of California coastal streams of comparable size. The stream stretches about 12 miles from the coast up to the northerly headwater sources at approximately 1900-2200 feet elevation. The total hydrographic basin encompasses nearly 22 square miles.

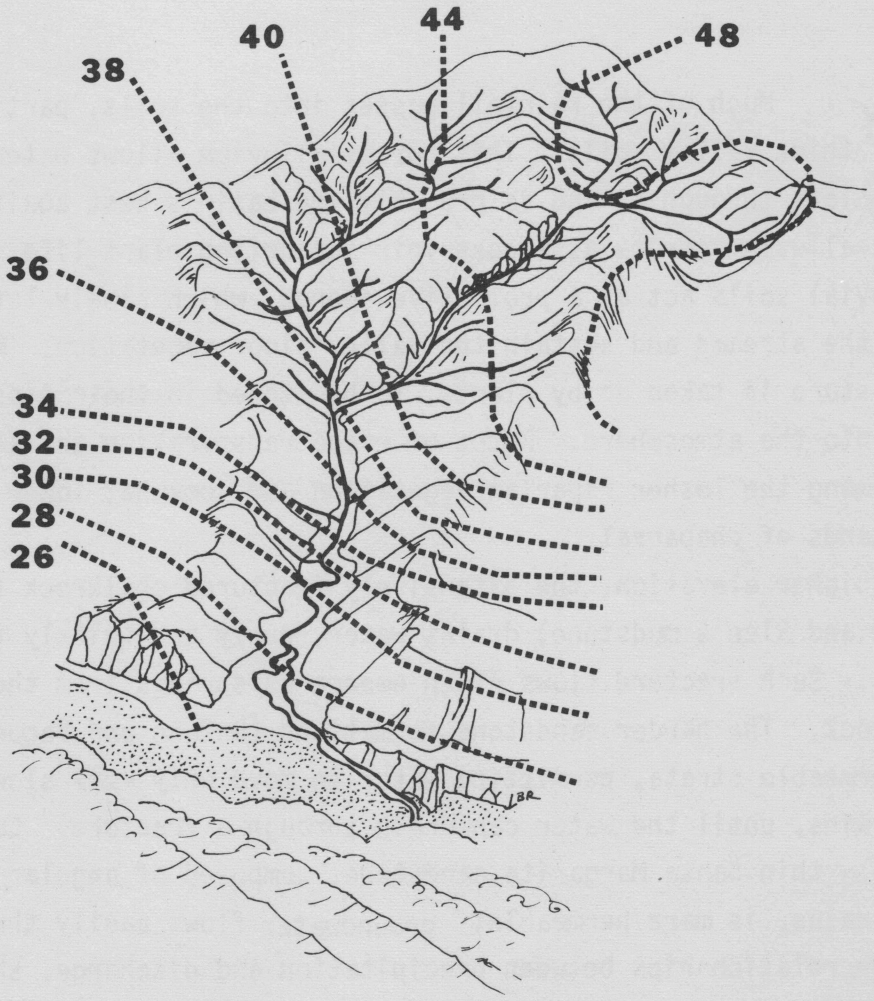
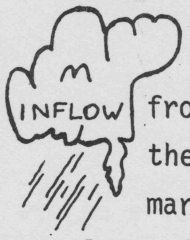
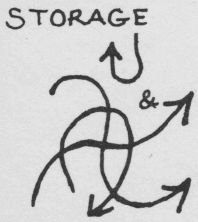


Fig. 11 Map of Estimated Precipitation (after Rantz, 1971)
Note change in isohyet interval at 40 inches



Mean annual rainfall in the Waddell basin ranges upwards from 50 inches at the headwaters to a low of 26 to 30 inches at the mouth (Rantz, 1971). Distinct wet and dry seasons create a marked fluctuation in stream flow. Normally more than half of the annual precipitation occurs in December through February; 90% falls between November and May. Precipitation is almost entirely in rainfall, with the low coastal fog contributing perhaps only half an inch per year near the shore. Coastal fog may, however, function as a significant meteorologic source of mineral salts, influencing the chemical composition of water in the Waddell.



Much of the rainfall passes into the soils, particularly the thick valley soils. This porous alluvium allows water to percolate through it and is probably the basin's best aquifer. The alluvium serves as a reservoir supporting plant life. In general, the alluvial soils act as a protective sponge, which slowly lets out water to feed the streams and sustain the valley floor vegetation. Much of the soil moisture is taken up by plants, to be stored in their tissues or transpired into the atmosphere. Rates of evapotranspiration are assumed to be higher among the lusher riparian vegetation and somewhat lower among the hardy stands of chaparral.

At higher elevation, the extensively fractured chalkrock (Santa Cruz mudstone and Rice's mudstone) drains water freely and quickly through its fissures. Such fracture flows often emerge as springs from the joints within the rock. The harder sandstone formations (Butano and Vaqueros) are the least permeable strata, permitting water to move only very slowly between their grains, until the water can drain through a fracture. Conversely, the relatively thin Santa Margarita sandstone, composed of angular and loosely-packed grains, is more permeable; groundwater flows easily through it.

Some relationships between precipitation and discharge, shown in Fig. 12, likewise suggest that the rock formations of the watershed have little long-term storage capacity. During the dry season, usually ranging from June to October, the monthly discharge quickly drops to a fraction of the

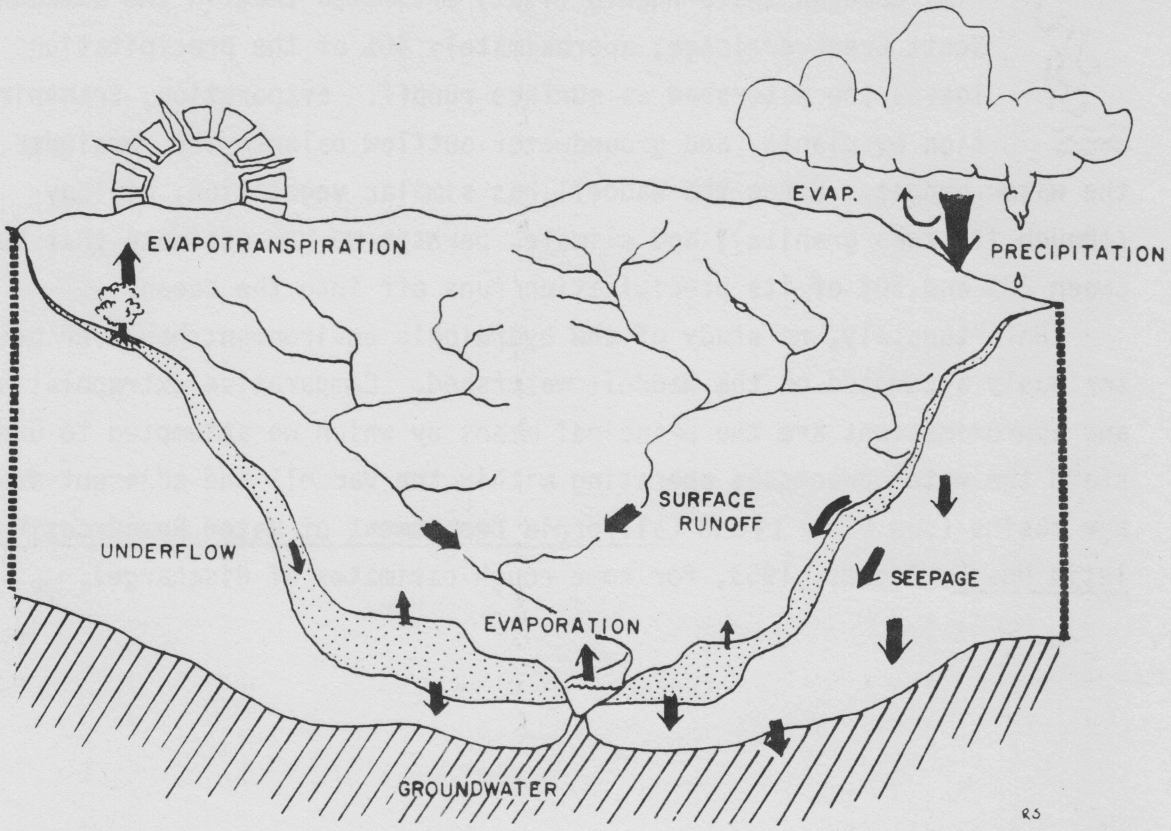
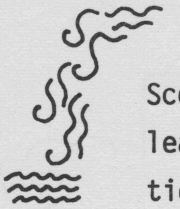


Fig. 12 Schematic Basin Hydrologic Cycle for the Waddell

wetter months' rates of stream flow. Perhaps more significant is the responsiveness of the stream system to seasonal variations in rainfall. Also, the baseflow at the end of each dry season closely reflects the total amount of rainfall received during the wet season.

The low long-term storage characteristics of the Waddell and Scott basins are due to the dense stream network which is incised deeply into the local bedrock. These canyons effectively drain the groundwater.

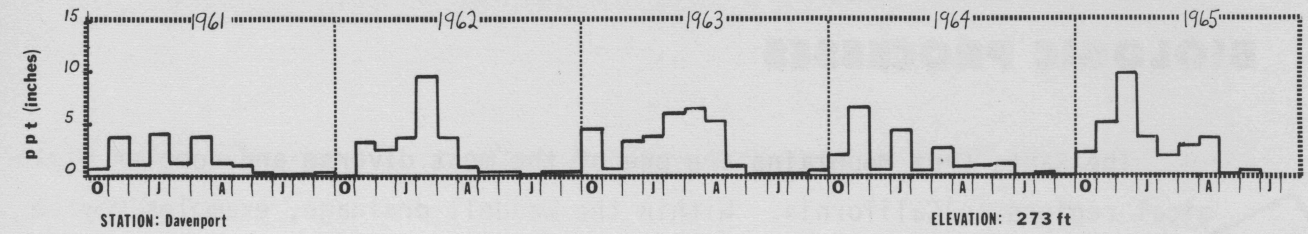
OUTFLOW



Creegan and D'Angelo (1960) estimated that in the adjacent Scott Creek drainage, approximately 40% of the precipitation leaves the watershed as surface runoff. Evaporation, transpiration by plants, and groundwater outflow balance the remainder of the water budget. Since the Waddell has similar vegetation, geology (though it lacks granite), and climate, perhaps we can estimate that between 30% and 50% of its precipitation runs off into the ocean.

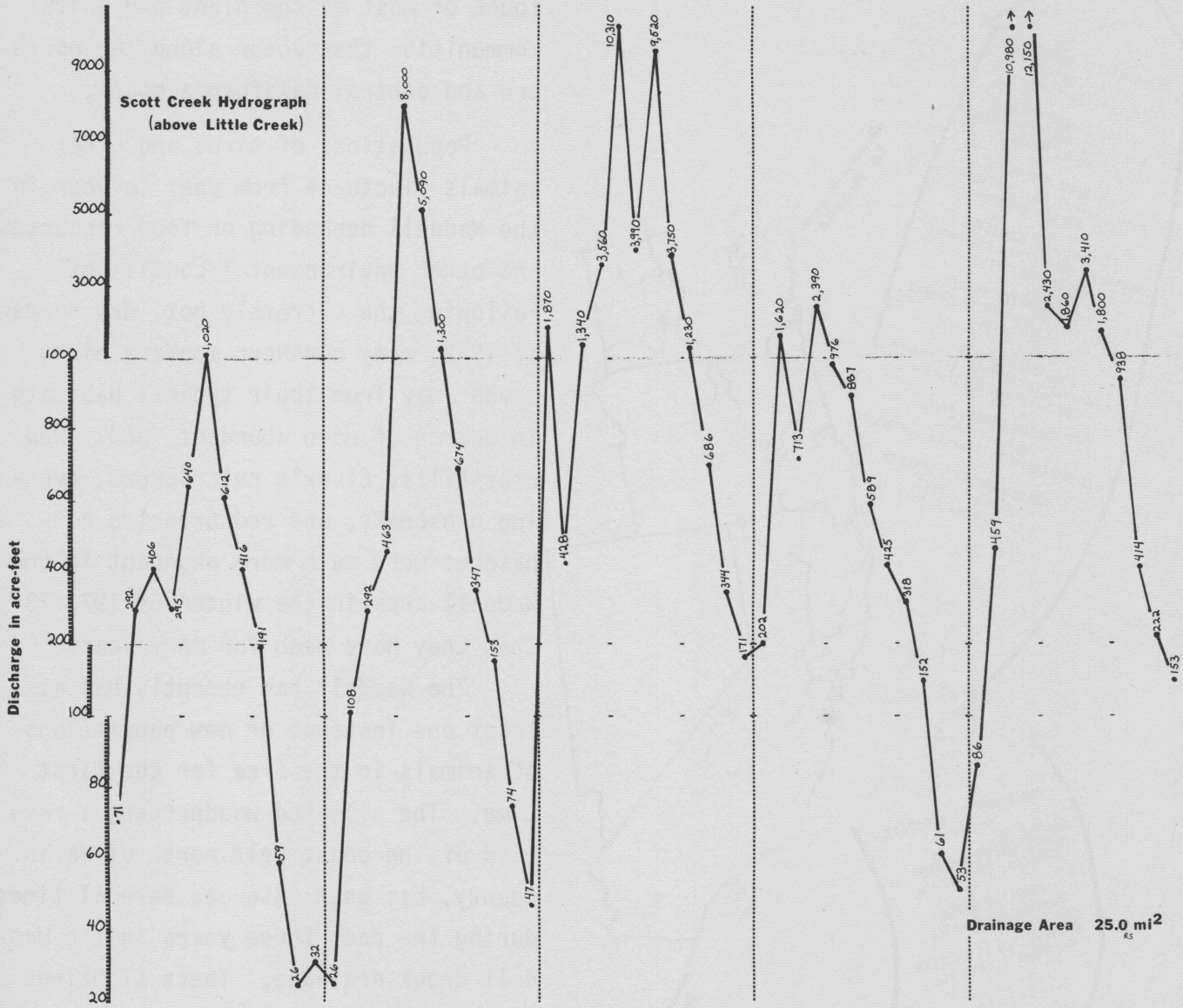
Unfortunately, no study of the hydrologic environment has ever been seriously attempted on the Waddell watershed. Comparative extrapolations and approximations are the principal means by which we attempted to understand the water processes operating within the Waddell and adjacent drainage basins (see Fig. 13 and California Department of Water Resources Bulletin No. 5, August, 1953, for some rough estimates of discharge).

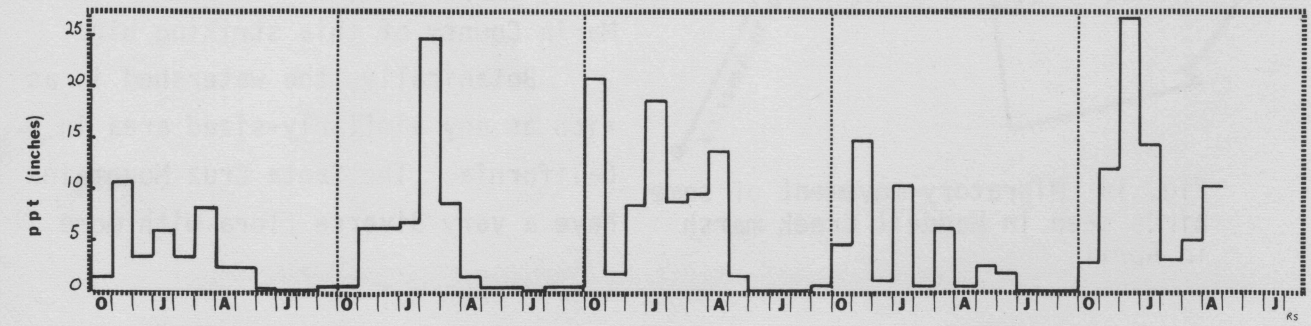
Fig. 13 Seasonal Variations and Relationships between Precipitation and Discharge within Scott Creek Basin (these can be considered representative of the Waddell)



STATION: Davenport

ELEVATION: 273 ft





STATION: Locatelli Ranch

ELEVATION: 2200 ft

BIOLOGIC PROCESSES

The Santa Cruz Mountains are one of the most diverse and complex biological regions in California. Within the Waddell drainage, examples may be found of most of the plant and animal communities that occur along the northern and central California coast.

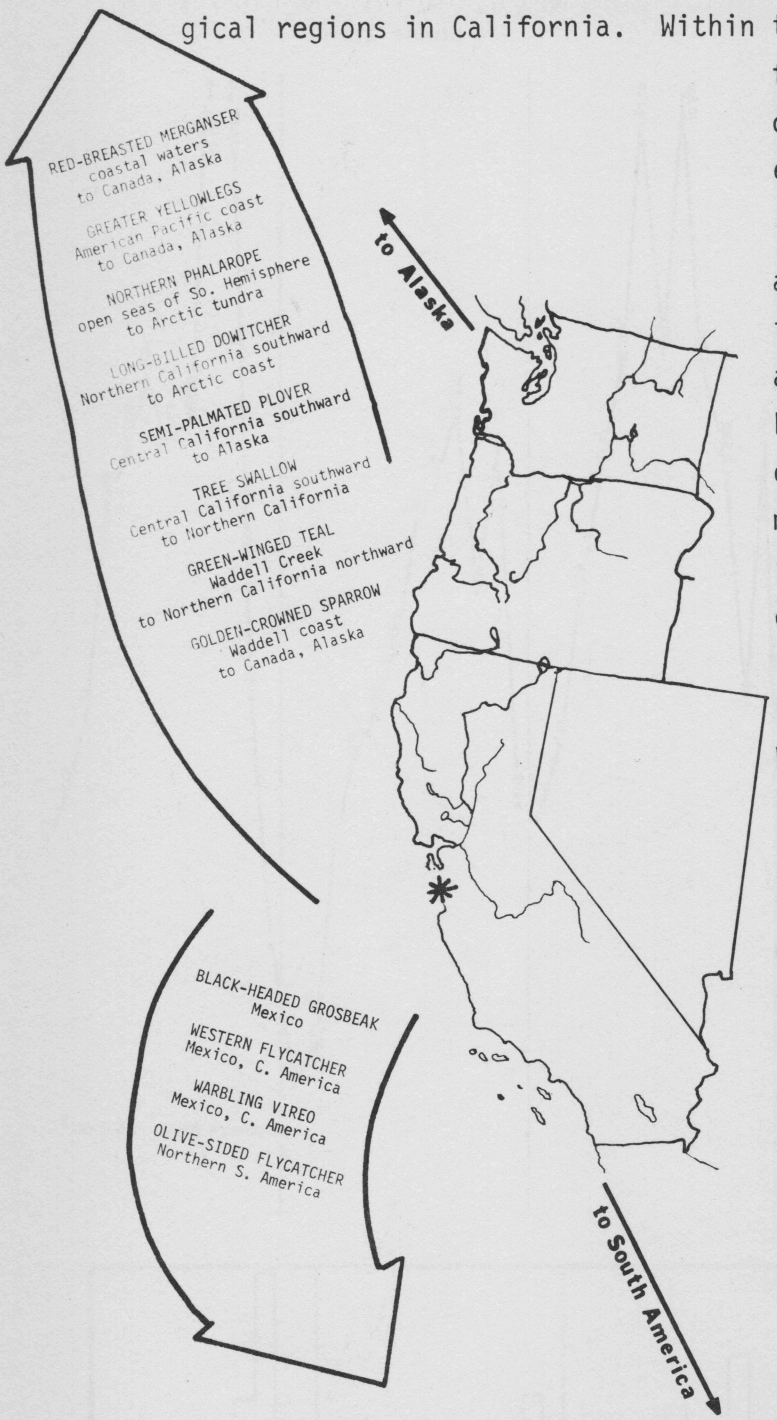


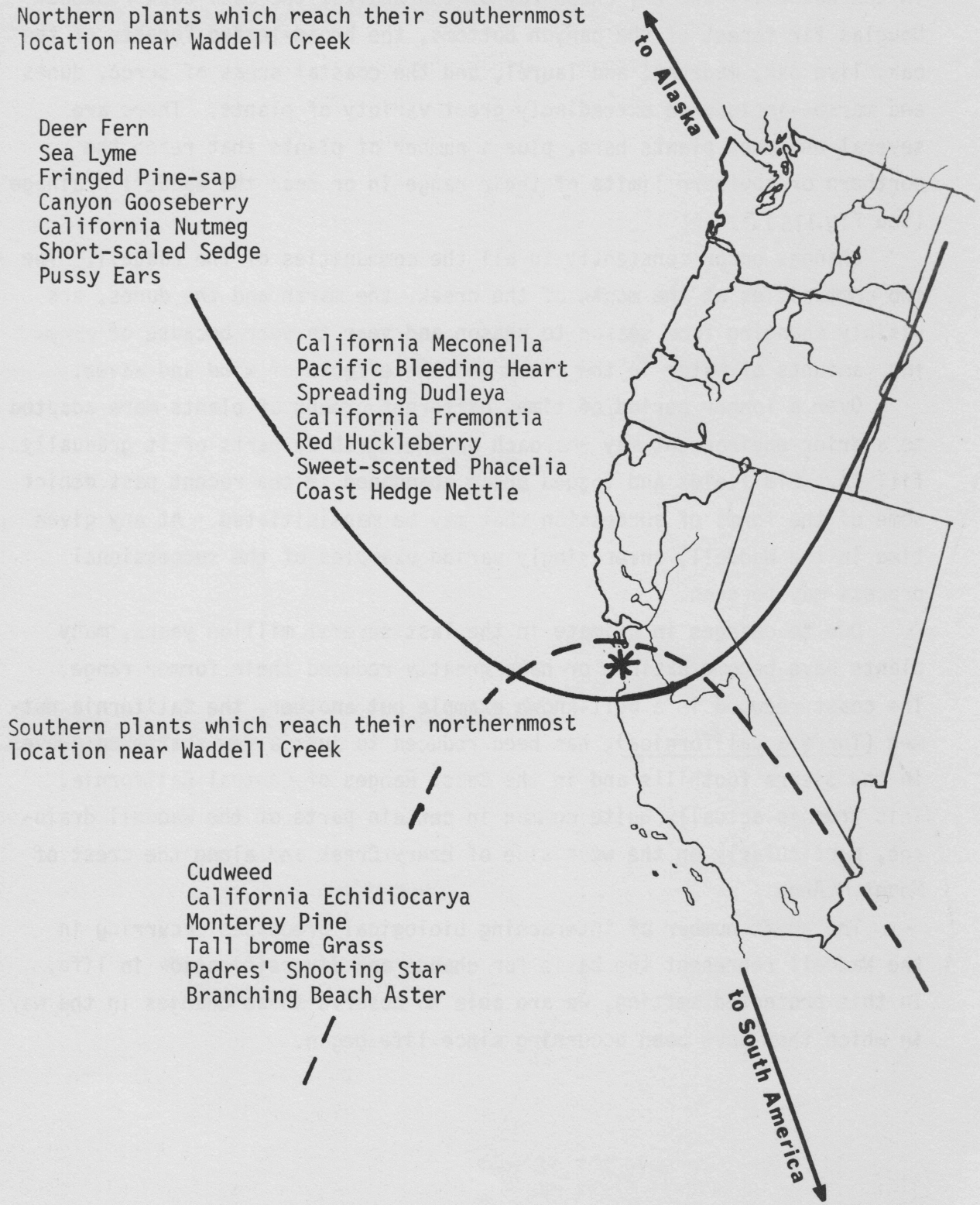
Fig. 14 Migratory movement of some birds seen in Waddell Creek marsh in April

Populations of birds and other animals fluctuate from year to year in the Waddell depending on food resources and other environmental conditions. Following the extremely hot, dry summer of 1972, many northern montane birds moved away from their typical habitats in search of more abundant food. Red crossbills, Clark's nutcrackers, evening grosbeaks, and red breasted nuthatches were much more abundant in the Waddell area in the winter of 1972-73 than they have been for many years.

The Waddell has recently had at least one instance of new populations of animals in the area for the first time. The pileated woodpecker, a rare bird of the coast belt north of Marin County, has been observed several times during the past three years in the Waddell Creek drainage. These sightings have been the first reports south of Marin County of this striking bird.

Botanically, the watershed is as rich as any similarly-sized area in California. The Santa Cruz Mountains have a very diverse flora with more

Fig. 15 Plants that reach their geographical limits in the Waddell area



than 1900 native taxa being represented. The great diversity of habitats in the Waddell-- the dry chaparral of the Chalks, the cool dark redwood-Douglas fir forest of the canyon bottoms, the broad-leafed forests of tan oak, live oak, madrone, and laurel, and the coastal areas of scrub, dunes and marsh--include an exceedingly great variety of plants. There are several uncommon plants here, plus a number of plants that reach the northern or southern limits of their range in or near the Waddell drainage (see Fig. 15).

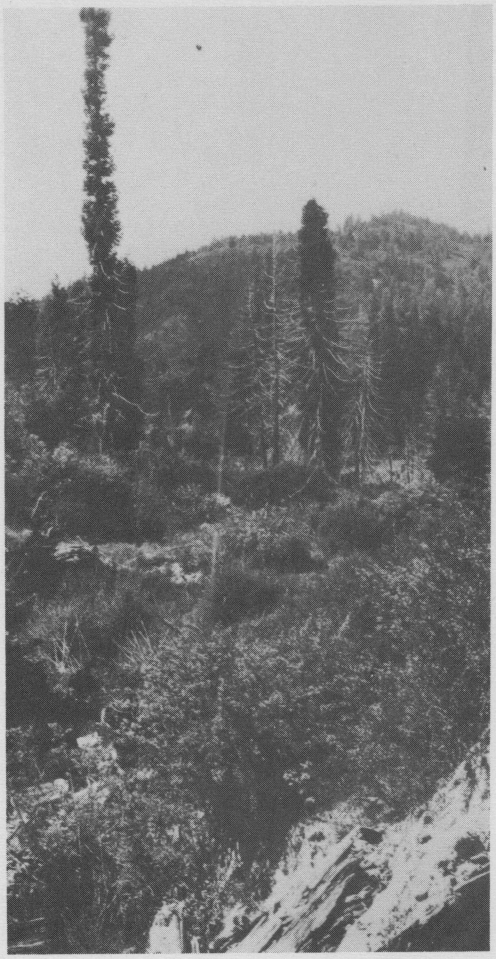
Changes occur constantly in all the communities of the Waddell. The two communities at the mouth of the creek, the marsh and the dunes, are visibly changing from season to season and year to year because of varying amounts of water in the creek and the effects of wind and waves.

Over a longer period of time, different groups of plants more adapted to a drier environment may encroach on the marsh as parts of it gradually fill in. Old fields and logged areas abandoned in the recent past depict some of the forms of succession that may be man-initiated. At any given time in the Waddell, surprisingly varied examples of the successional process may be seen.

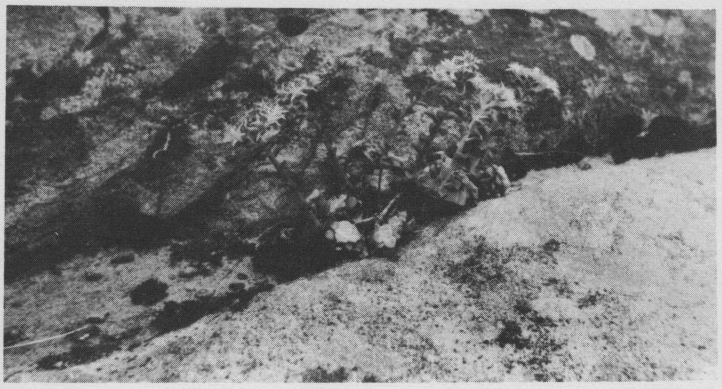
Due to changes in climate in the last several million years, many plants have become extinct or have greatly reduced their former range. The coast redwood is a well-known example but another, the California nutmeg (Torreya californica), has been reduced to just a few scattered groves in the Sierra foothills and in the Coast Ranges of Central California. This tree is actually quite common in certain parts of the Waddell drainage, particularly on the west side of Henry Creek and along the crest of Mount McAbee.

The great number of interacting biological processes occurring in the Waddell represent the basis for change and diversification in life. In this protected setting, we are able to observe these changes in the way in which they have been occurring since life began.

Encroachment of Coyote Brush and Monterey Pines on Coastal Prairie and Last Chance Road



Succession on a burned area near the Last Chance Mill Note re-sprouting redwoods (fire columns)



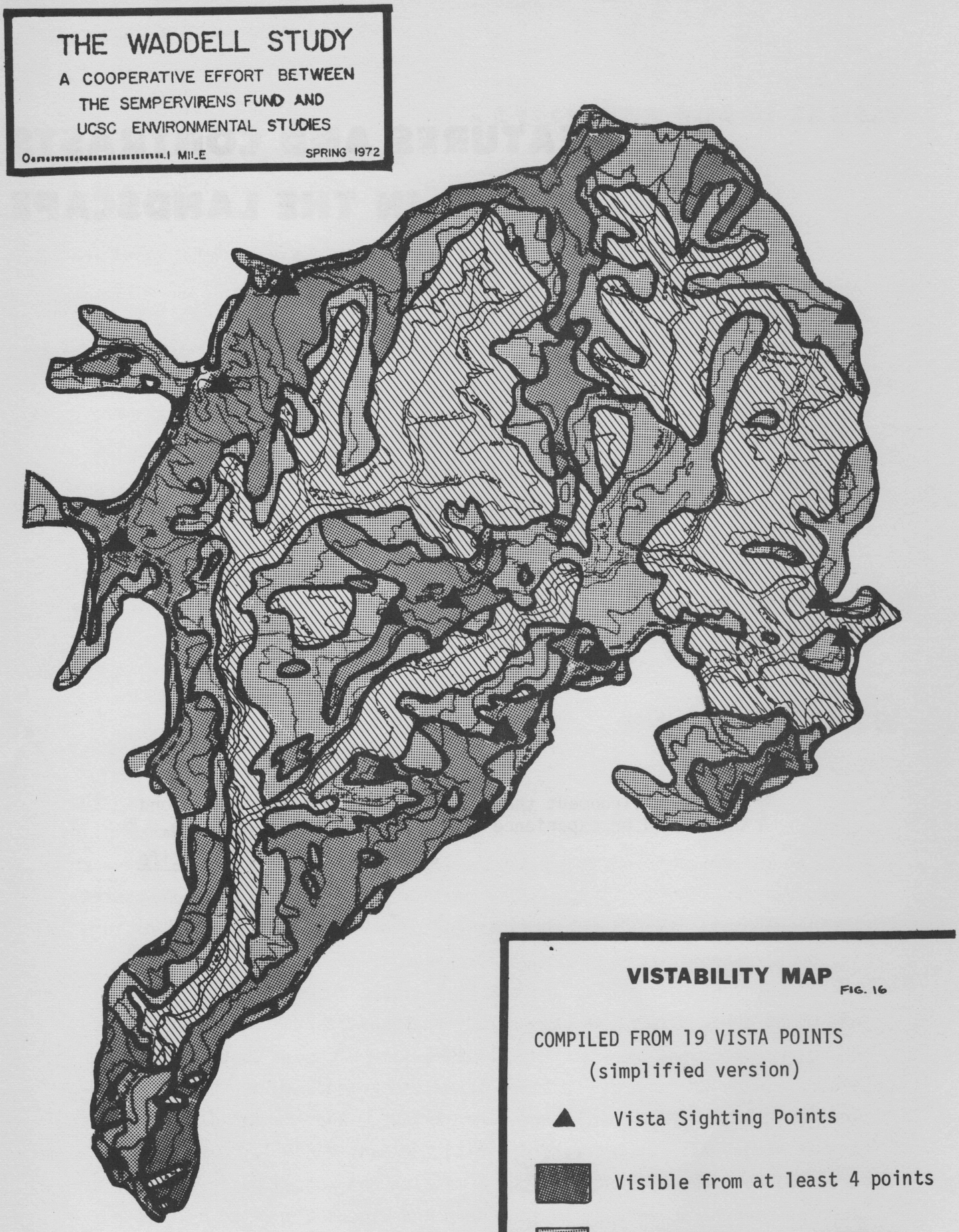
Primary succession on a sandstone outcrop near Eagle Rock. Plant in the center is common Stonecrop; other plants are mosses and lichens.

THE VISITOR'S PARKSCAPE

FEATURES AND CONTRASTS IN THE LANDSCAPE

"...the environment that supports life extends far beyond the vision or experience of the things that live there..."

John Storer, The Web of Life



VISTABILITY MAP FIG. 16

COMPILED FROM 19 VISTA POINTS
(simplified version)

▲ Vista Sighting Points

Visible from at least 4 points

Visible from 2 or 3 points

Visible from 1 or no points

VISUAL IMAGE AND VISTAS

Analysis of visual image can identify the parts of the landscape that serve to orient us, to give us a sense of place.

Much of our work was concerned with vistas - the long-range views from mountaintops, ridges, and open areas along roads and trails. The more commanding landforms (notably, the mountains, the steep canyon walls, and the flat expanse of the valley floor) are important elements of orientation. Yet the commanding views are often the most sensitive. The visual texture of the Waddell emphasizes any major road or logging cut that exposes the bright white chalkrock. Any disturbance can destroy or detract from the harmony of the vistas.

We selected 19 of the most representative vista points and mapped the areas that may be seen from that spot on a standard topographic sheet. These data were compiled and simplified to produce the Vistability Map (Fig. 16). Hopefully, the map can aid planners in determining which areas need special scenic consideration.

WATER FEATURES

Water flowing within the Waddell basin travels many paths between the headwaters and the ocean, each pathway with its own special characteristics.

In the eastern limits of the drainage, Upper Opal Creek cascades down steep canyons strewn with man-sized boulders and fallen trees. Downstream, the gradient is flatter and numerous potholes and larger depressions form in the hard bedrock and fill with turquoise colored water.

Bloom Creek originates above a flat saddle known as Little Basin and winds through level terrain beside the headwaters of the Scott Creek drainage. Plunging down a narrow boulder-filled canyon to the gentle floodplain on the downthrown side of the Ben Lomond Fault, the creek follows a relatively flat path over sandy alluvium and fractured sandstone until it merges with Opal Creek, creating the East Waddell.

The East Waddell cuts through a massive and rugged gorge. The water tumbles over hard bedrock, forming deep and wide pools edged by smooth

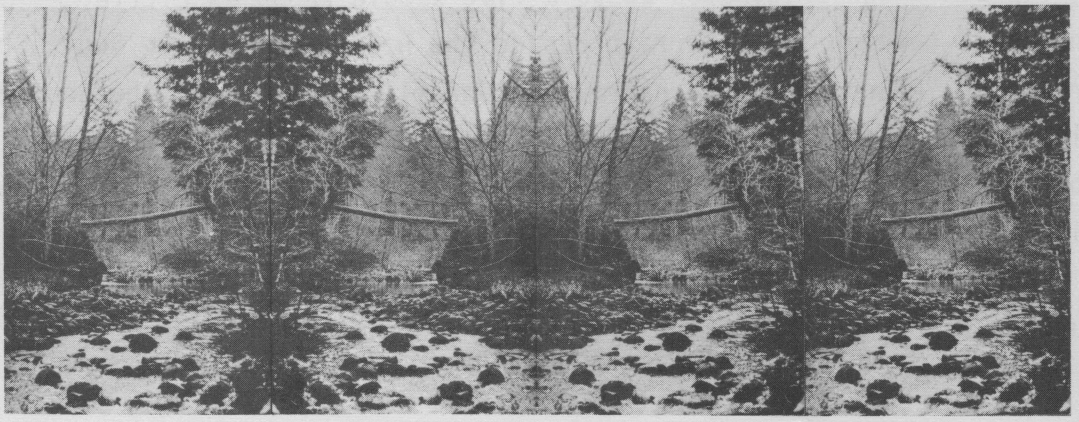
rocks. Below Vogt's Pond, the creek levels and drops sharply through a rocky narrows. It then becomes a placid stream again, winding between occasional large boulders that have fallen from the slopes.

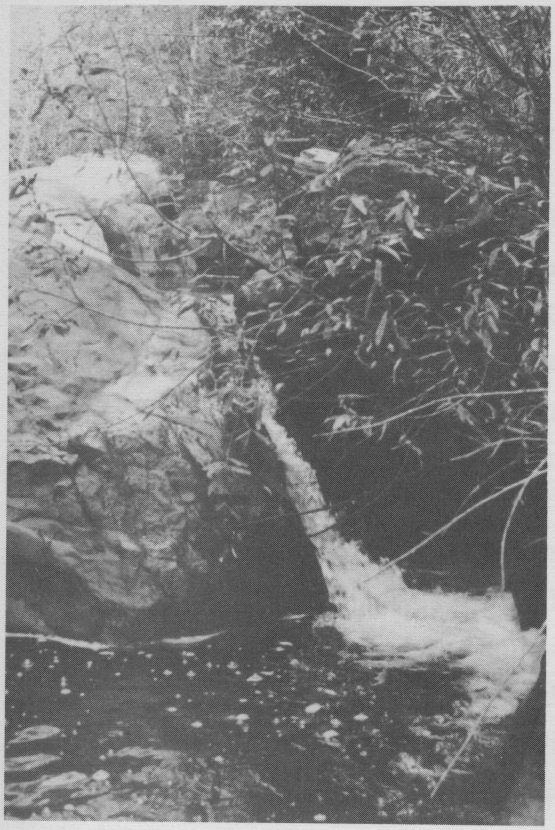
The upper reaches of the coastal floodplain meet the East Waddell where Last Chance Creek trickles in. The south fork of Last Chance Creek has steep walls with small waterfalls flowing over the yellow-white chalkrock during the wet months of the year. Old roads and a few shacks reflect the logging past. Timber retrieval was limited by the steep-walled canyon; virgin redwoods remain where they were felled across the creekbed.

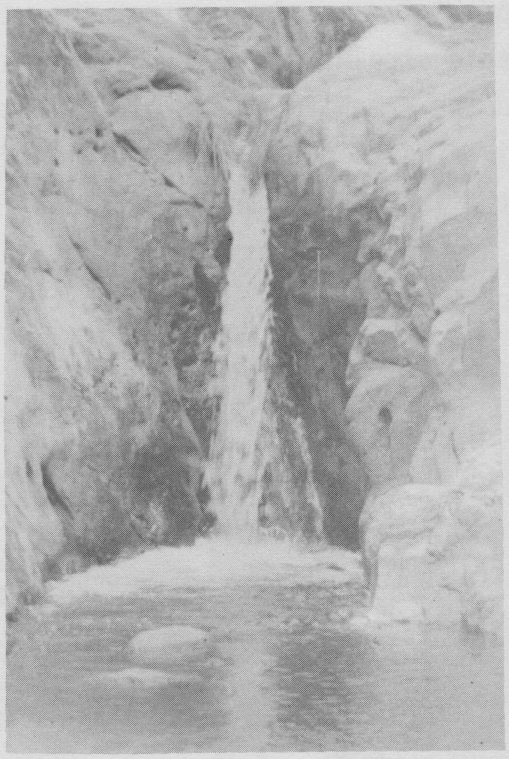
The most spectacular falls in the watershed are along Berry Creek, three miles upstream on the West Waddell from its confluence with the East Waddell. On the west branch of Berry Creek, cascades and sheets of water glance over the slopes of Golden and Upper Falls. At the Lower Falls, water pours straight down over the rim, splashes over a propped log, and flows around a bend into West Waddell, where it glides over tables of exposed bedrock.

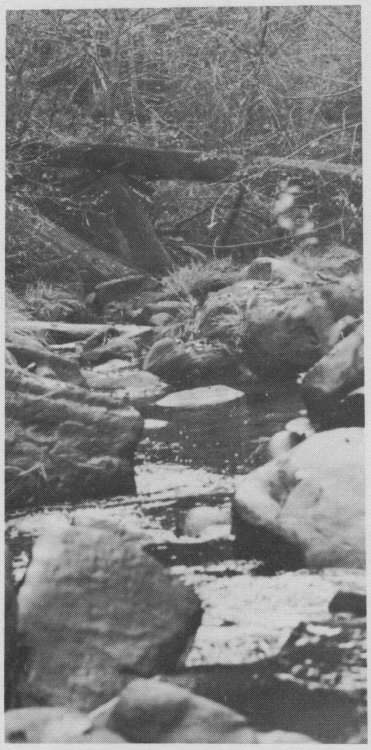
Before reaching the East Fork, the West Waddell widens as it enters the coastal valley bottomlands and meets the East Fork. Large maples, alders, and redwood are rooted in the rich alluvium. The clean gravel provides a haven for the chain of life: spawning salmon and steelhead, and copulating rough-skinned newts.

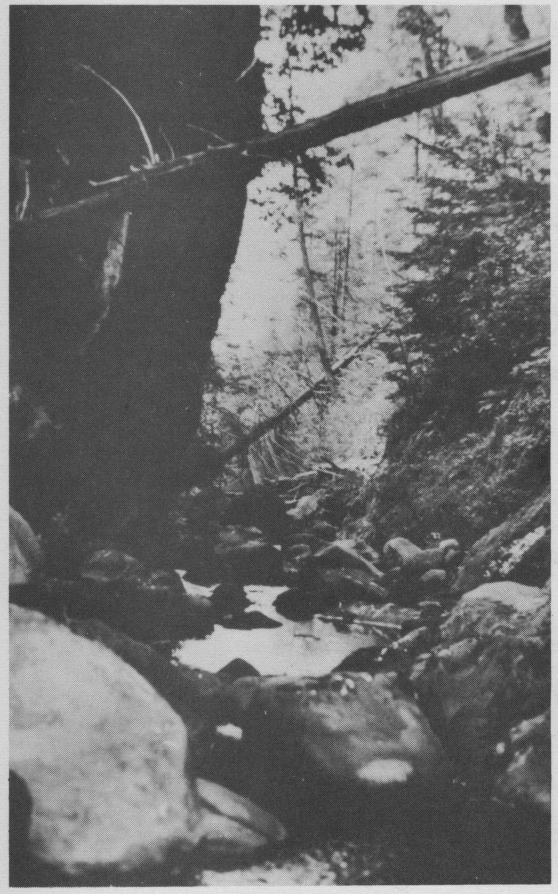
Farther downstream, the Waddell tunnels through mixed riparian and forest growth, the still waters mirroring the streamside vegetation. The directionless, secluded mood is left behind as the creek breaks into the open, flowing slowly through the fields, pastures, and ranch buildings into the freshwater marsh. The Waddell drops over a dam, under the Coast Highway and through the dunes to the ocean.











WATER CONTRASTS

Some of the most striking contrasts are along East Waddell Creek. At the headwaters in Big Basin, the East Fork is shallow, with water rippling over smooth, flat rock. Except for a few stagnating ponds, where sewage discharge and sudsing agents accumulate, the water is clear and quickens when it enters the gorge. Logs and massive boulders block the creek at many points creating waterfalls and fast ripples; past the gorge, the boulders are smaller and the water shoals and slows.

During fall, the maple trees are golden, contrasting sharply with their bare skeletons of winter, reminiscent of the withered New England landscape with its icy, rapid streams. By spring, the surrounding land becomes green and prolific and the creek fresh and clean; but by summer the land is dry and the creek gives off a musty odor. (This odor may be attributable to the effluents from the increased summer traffic at Big Basin; however, other possible causes are being investigated.) By late summer, the creek is nearly dry, yet quickly regains its vigor with the rains of winter.

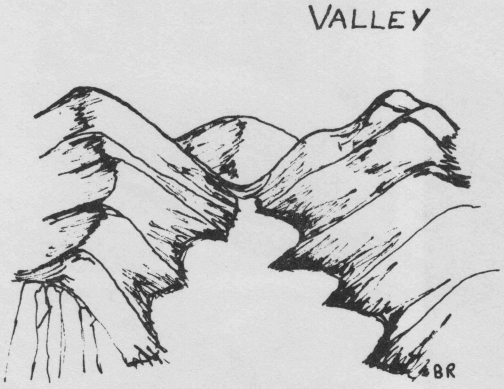


Fig. 17
An open broad alluvial plain rimmed by steep slopes gradually narrowing to a canyon. Largest low-lying flat area in the watershed, it gives a feeling of protected spaciousness.

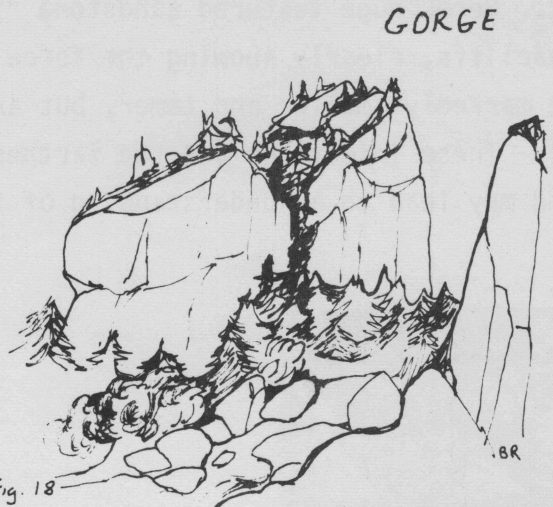


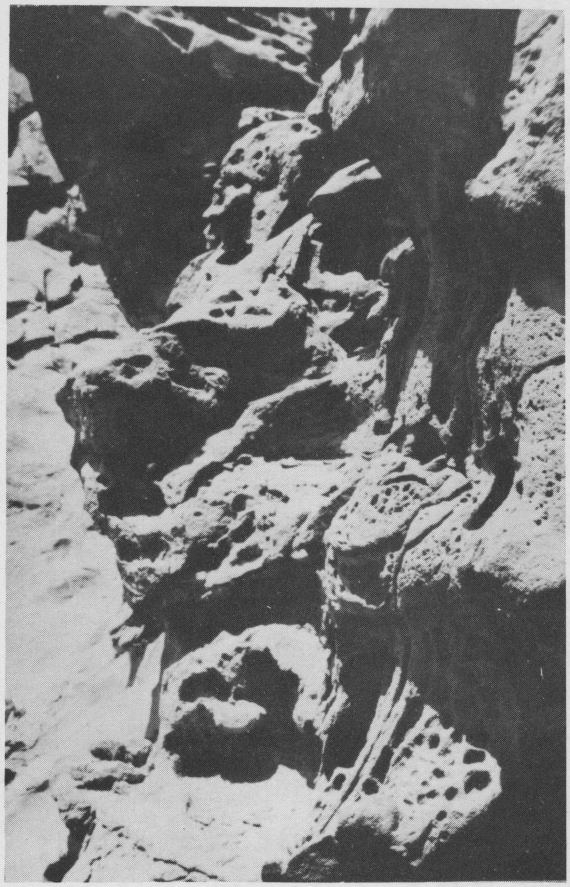
Fig. 18
Though the East Fork is the most spectacular example of the water – earth interface, the short walled in view is a true image dynamic for most of the Waddell tributaries.

FEATURES OF ROCKS AND SOILS

The rock types of the watershed are nearly all sandstones and mudstones, interbedded in various ways. The topography can be linked to the subtle differences and relationships among these sedimentary rocks. The sheer drops of Berry Creek Falls are controlled and maintained by resistant beds of Santa Cruz mudstone. Solid Butano sandstone gives the East Waddell cliffs their massive ruggedness, a ruggedness in contrast to the finely laminated folded sands and silts, grained like delicate wood, that are exposed in the Butano outcrops along Gazos Creek Road. In further contrast to the cliffs, isolated knobs and saddles are typical of landscapes found on the Vaqueros sandstone.

Yellow-orange bands of decomposed sandstone exposed along Last Chance Road and on Mount Shelby tell of major natural convulsions several million years ago. Sand deposited as part of the Santa Margarita Formation was forcibly injected into the overlying mudstone ("chalkrock") by water and natural gases under great pressure. This action seems to have been centered ten miles to the southeast near what is now the coast between Santa

Cruz and Davenport. Here, huge textured sandstone "intrusions" are exposed in quarries and seacliffs, clearly showing the force of injection. Those in the Waddell are markedly smaller and tamer, but are of both popular and technical interest. These injections are the farthest known from the center of activity and may lead to an understanding of this curious geologic event.



The watershed contains numerous geologic landmarks, one of which is the East Waddell gorge. Honeycomb weathering of this sandstone has sculptured numerous caves, holes and tunnels in the cliff walls.
Fig. 19

CONTRASTS OF ROCKS, SOILS, AND LANDFORMS

Even the geologic amateur can observe the major contrasts in the rocks of the Waddell. The watershed graphically exposes the slow but incessant changes of the earth, and portrays the development of mountains and soils.

Big Basin is a theater curtained by the scarp of the Ben Lomond Fault, with the outstanding remnants of the fault's uplift, Ben Lomond Mountain,

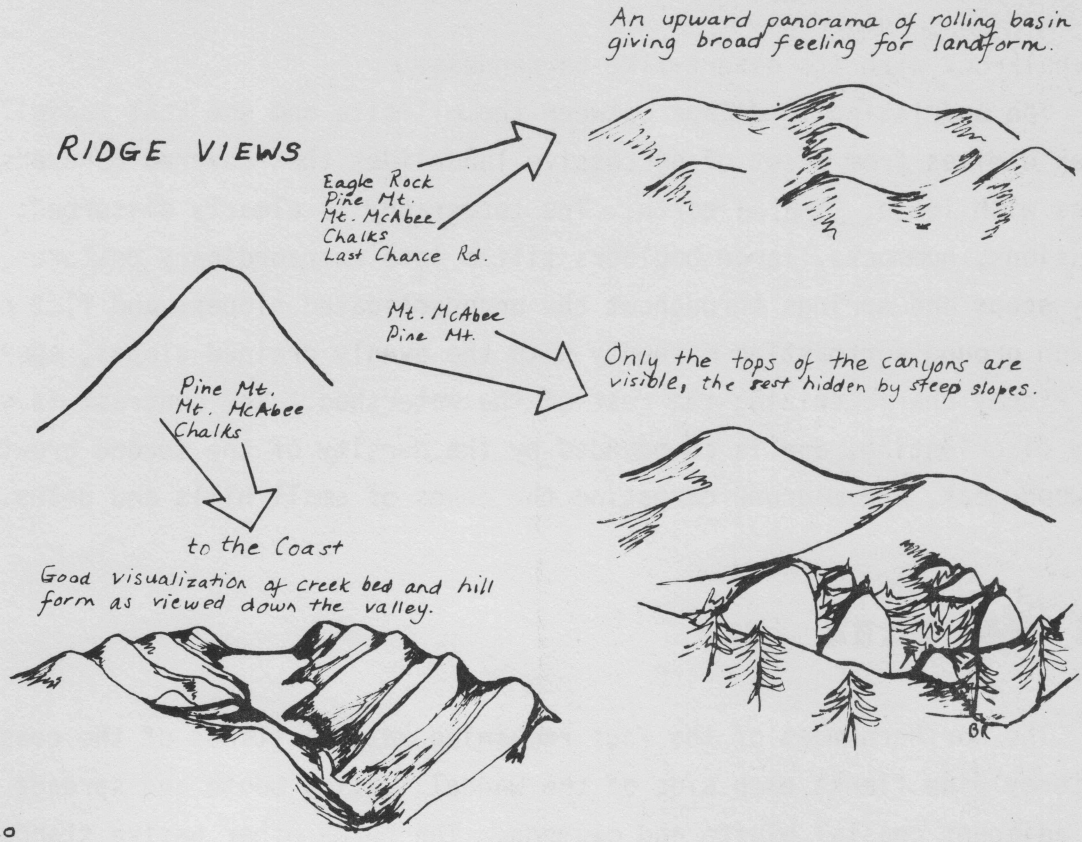


Fig. 20

Pine Mountain, and Mount McAbee, forming the backdrop. The deep alluvial soils anchoring redwoods and firs have developed in the stream deposits that backed up behind the fault over millions of years.

Above the Basin toward the coast, markedly distinct soils and vegetation have evolved over different rock types. Just after reaching the crest of Mount McAbee, Hihn Hammond Road crosses the transition from the brown, cemented Butano sandstone to the dry, light-colored and highly fractured Santa Cruz mudstone, or "chalkrock". The sparse growth of knobcone pine and chaparral surviving on the thin soil of the Chalks is a startling change from the dense forests of redwood and madrone. The same abrupt break occurs at other geologic contacts, such as at the end of the Sunset Trail near Berry Creek.

An even more varied rock face highlights the cliffs above South Pine Mountain Road, near the Last Chance millsite. Here, large outcroppings of granodiorite are faulted above the orange Butano deposits, topped by tall grey cliffs of delicately weathered Santa Margarita sandstone, and capped

by chalkrock with its desert-like barrenness.

The undulating landscape between the millsite and the East Waddell Creek derives from a set of successive landslides that covered hundreds of acres with loose, jumbled earth. The topography is clearly disturbed: depressions, hummocks, large boulders tilted into extraordinary postures, tiny seeps and springs throughout the unconsolidated slopes, and flat or uneven ground contrasting markedly with the evenly drained slopes, spurs, and ridges characterizing the rest of the watershed. The contrast is visually disorienting, and is compounded by the density of the second growth of redwood, oak, and madrone carpeting the chaos of small hills and dales.

LIFE FEATURES

The northern-most of the four remaining natural stands of the coastal Monterey pine flanks each side of the Waddell valley mouth and spreads over the adjacent coastal bluffs and canyons. The three other native stands are near Monterey, at Cambria, and on Guadalupe Island off Baja California. This Monterey pine forest is a successional climax. Occupying an area just back from the coast, it is exposed to the full force of coastal winds. Douglas fir and redwood cannot tolerate this direct exposure and do not encroach on the pines.

On the ridges above the main Waddell valley, the Monterey pine hybridizes with the more common, but closely related, knobcone pine. Many of the pines on this ridge and adjacent slopes exhibit characteristics of foliage and cone morphology that are intermediate between those of the two species. This is the only known location where hybrids between these two pines occur.

Foresters and geneticists have come from all over the world to the Waddell and the other native stands to study the adaptations that these trees have made over thousands of years. Monterey pine is the most widely planted timber pine in the world, with extensive stands in Australia, New Zealand, Chile and elsewhere. Thus, an expanded understanding of Monterey pine growing in natural stands could prove to be of great commercial value. Moreover, in view of the history of disease among crop plants, it would be

wise to preserve the natural gene pool.

Perhaps the most interesting of the several other scarce tree species in the Waddell basin is the Santa Cruz cypress, which occurs in only four locations in the world, all within the Santa Cruz Mountains. A small, inconspicuous grove grows on the south-west side of Eagle Rock. It is intriguing to consider why they occur in such limited distribution, a question that continues to be closely studied (see photo, Eagle Rock Microstudy).

The leopard or panther lily, one of the most striking flowers of the area, grows along the upper reaches of West Waddell Creek. The leopard lily is fairly abundant in the higher North Coast Ranges and in the Sierra Nevada, but it is not common in this area. The flowers, blooming in June or July, are bright orange, mottled with dark purple spots. The plants may reach ten feet in height, and the flowers may be up to six inches in diameter.

LIFE CONTRASTS

The Waddell exhibits a wide variety of biotic communities, the boundaries of which are sometimes subtle and almost undetectable, but more often abrupt. From a distance, the mudstone outcrops of the Chalks are conspicuously barren, rising out of the thick forests below. The scrubby chaparral community abuts against the redwood forest, with no gradations blurring the sharp boundary between them. The Chalks seem all the more exposed and brittle when viewed from the comforting closeness of the forest, yet they host a thriving eco-community of dense brushy growth, sparsely covered pines, and a wide variety of birds and ground animals.

Alternating open and dense vegetation offers a recurring, unifying sequence throughout the study area. The Monterey pine forest on the eastern slopes of the valley opens onto the grasslands on the ridge above. In some places, where the grasslands have been maintained, the transition is abrupt. In other places, where forest and grassland meet in the confused jumble of a successional community, the transition is more gradual and the abruptness of emerging from the depths of the forest into the bright mead-

Fig. 21 Seven Plant Communities in the Lower Waddell Valley

ows is lessened.

Along the Berry Creek Falls trail, the desolate landscape of a logged redwood forest stands out sharply at the edge of the park boundaries. No sign or fence is necessary to indicate the boundary between park and private lands. The remainder of the trail ascends the Chalks, desolate in their own way, yet without the appearance of having been so unnaturally disturbed.

From an elevated point about one-half mile inland from the road at the base of the west slope, seven of the nine major plant communities of the Waddell Creek drainage can be seen. These communities are the Monterey pine forest; the riparian woodland; the redwood-Douglas fir forest across the valley; the coastal scrub community and, on the ridge along Last Chance Road, the chaparral community. The other two communities are the marsh and the dune areas, just down the road at the coast.

Last Chance Road traverses and reveals several different communities. The pastoral serenity of the meadows ends abruptly at the edge of the forest with its own, wilder peace. The road suddenly emerges into the glaring brightness of a steep mudstone outcrop and impenetrable scrubby vegetation. Here, sounds are no longer camouflaged by the wind in the trees, and the break in the forest bounds a view of the lower Waddell as it leaves the valley and winds its way through the sands to the ocean far below. The marsh and its host of wildlife can be seen and heard against the waves. Contrasted with the ever-changing pattern of the surf and dunes, the impression of the valley is one of a domesticated wilderness, where orchards and grazing lands occur among the lush streambanks and deep forests.

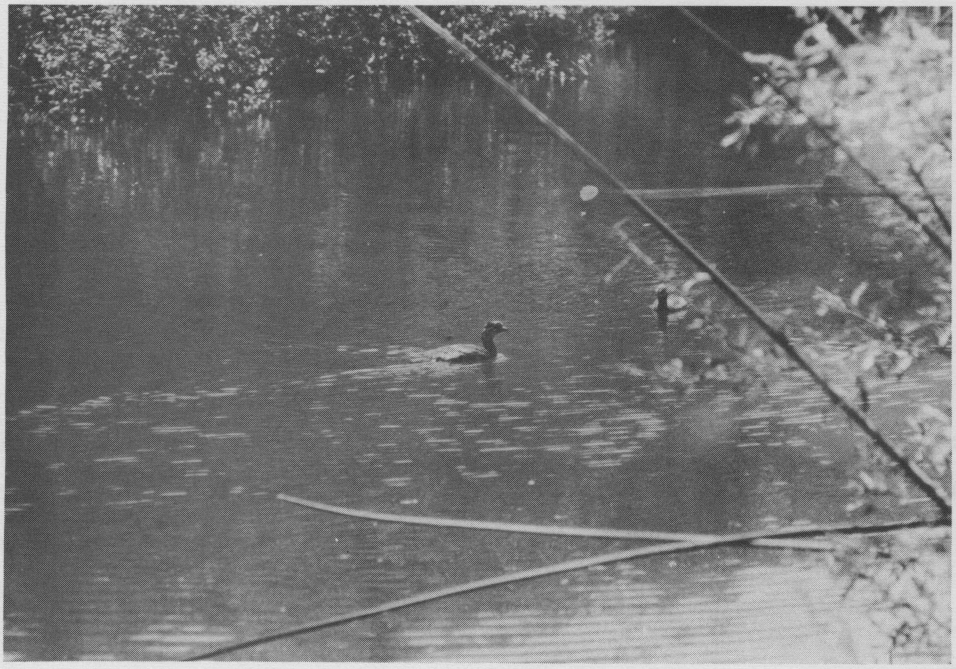
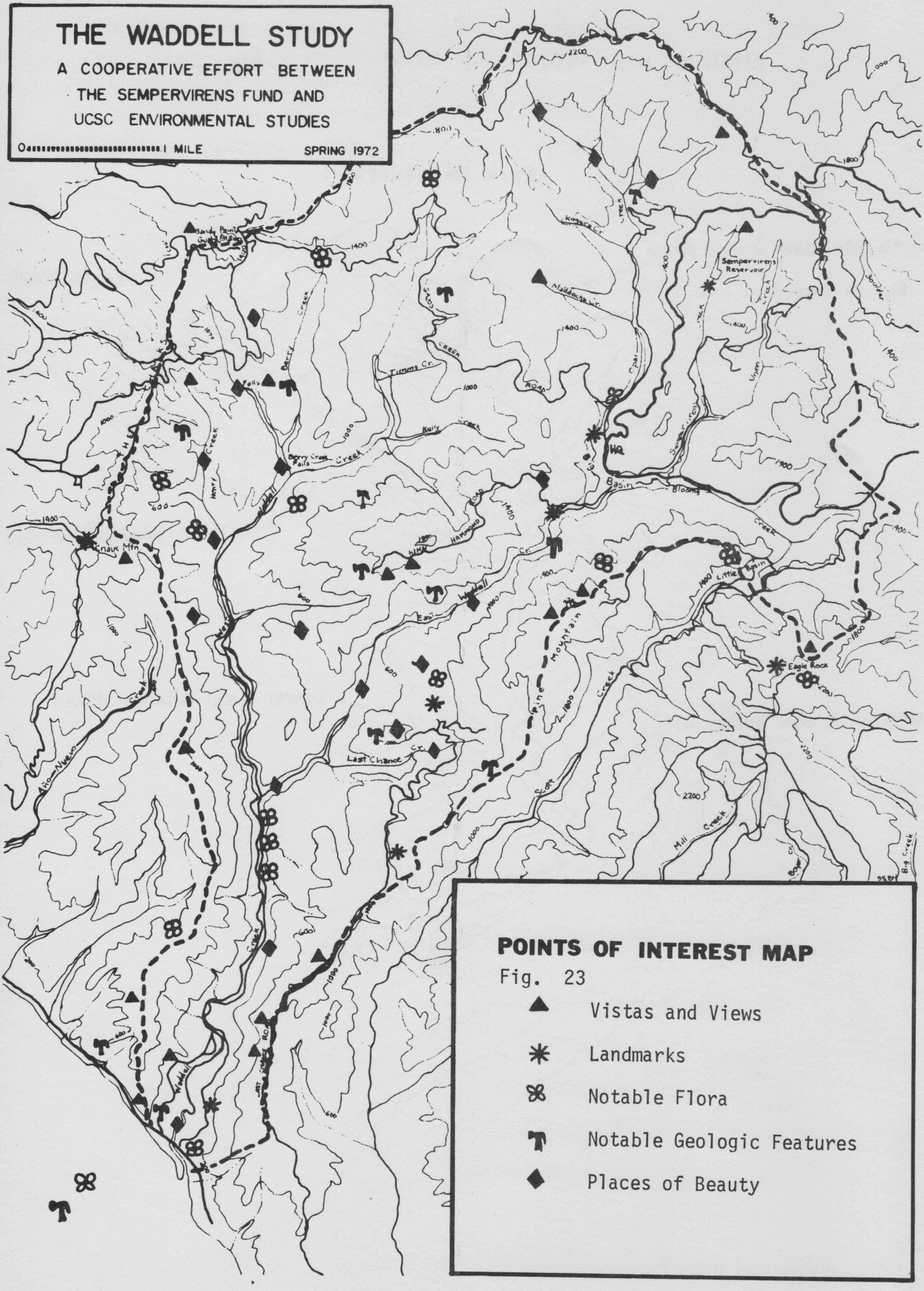
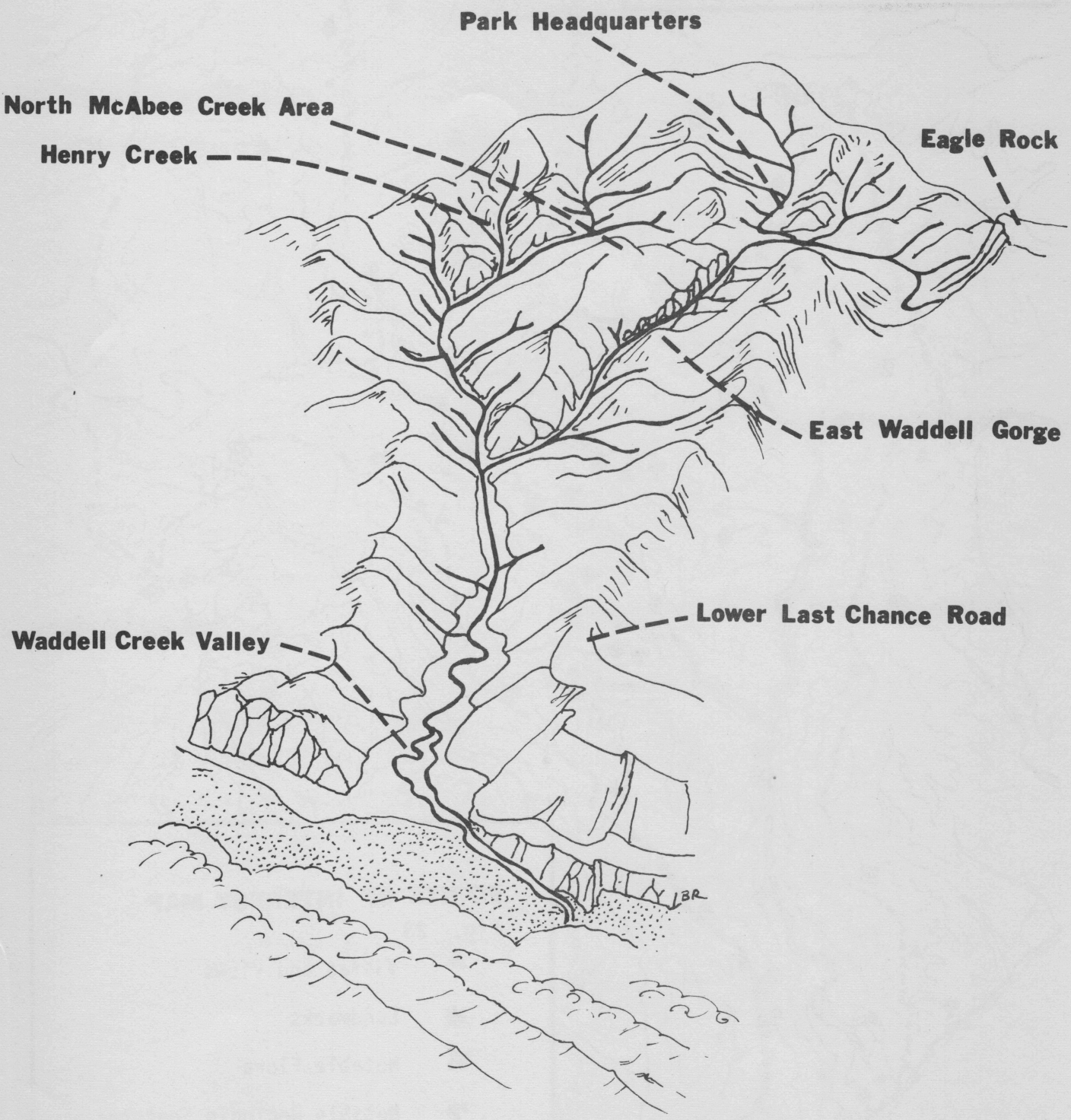


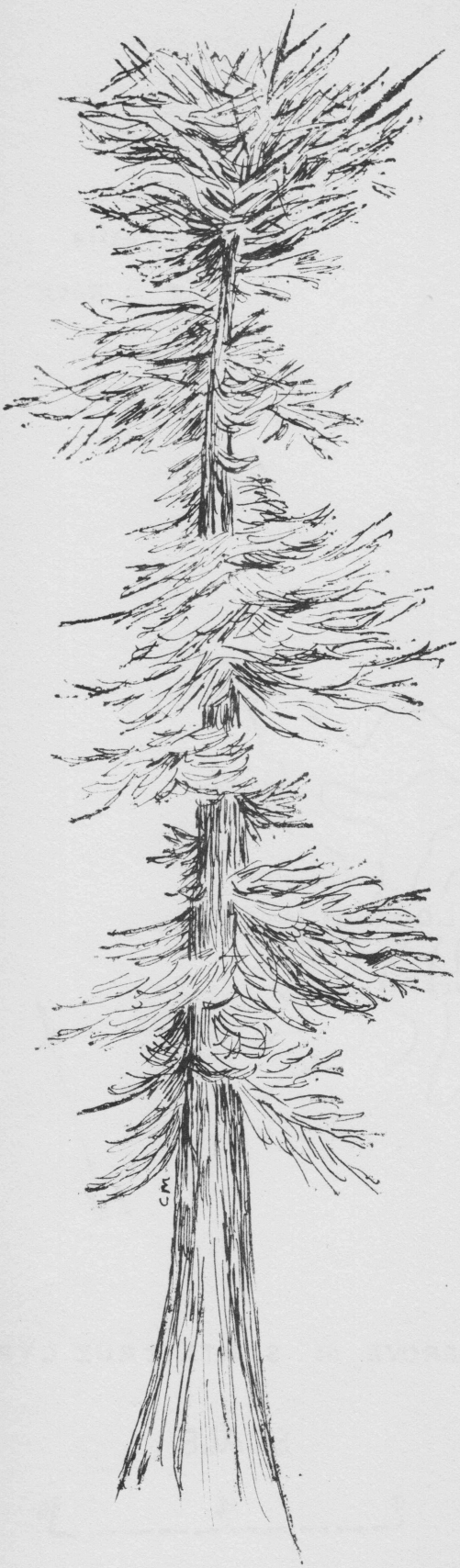
Fig. 22 Two Grebes in the Marsh


THE WADDELL STUDY
A COOPERATIVE EFFORT BETWEEN
THE SEMPERVIRENS FUND AND
UCSC ENVIRONMENTAL STUDIES
0 1 MILE
SPRING 1972
Sempervirens Reservoir
Maddocks Cr.
Timms Cr.
Kelly Creek
Berry Creek Falls
Falls
Berry Creek
Henry Creek
Waddell Creek
Big Basin
Blooms Creek
Little Basin
Eagle Rock
Pine Mountain
Last Chance Cr.
Scott Creek
Mill Creek
Big Creek
Año Nuevo Creek
Cnaik Mtn.
Bandy Point Guard Station
Sempervirens Creek
Opal Creek
Union Creek
Boulder Cr.
Rogers Cr.
Waddell Cr.
Hammond Road
Last Chance Road
Waddell
POINTS OF INTEREST MAP
Fig. 23
Vistas and Views
Landmarks
Notable Flora
Notable Geologic Features
Places of Beauty

MICROSTUDY INDICATOR MAP Fig. 24



MICROSTUDIES

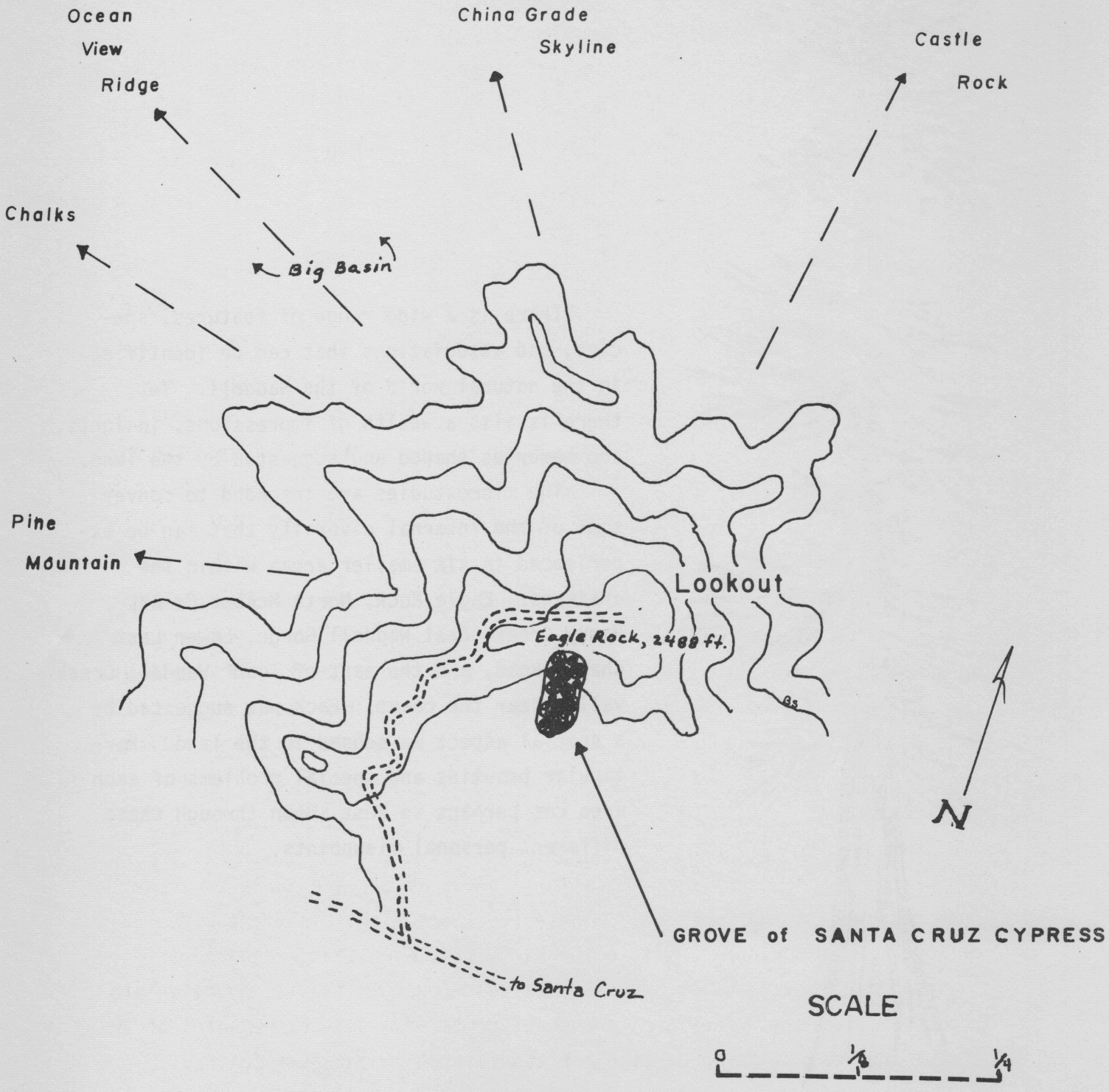


There is a wide range of features, species, and associations that can be identified in the natural world of the Waddell. Yet, there is also a wealth of impressions, insights, and memories shaped and suggested by the land.

The microstudies are intended to convey some of the internal diversity that can be experienced in six smaller areas within the drainage: Eagle Rock, North McAbee Creek, Henry Creek, East Waddell Gorge, Lower Last Chance Road, and the part of lower Waddell Creek valley near the coast. Each was suggested by a special aspect we sensed in the land. Particular beauties and special problems of each area can perhaps be best shown through these different personal viewpoints.

Fig. 25

EAGLE ROCK



EAGLE ROCK AREA

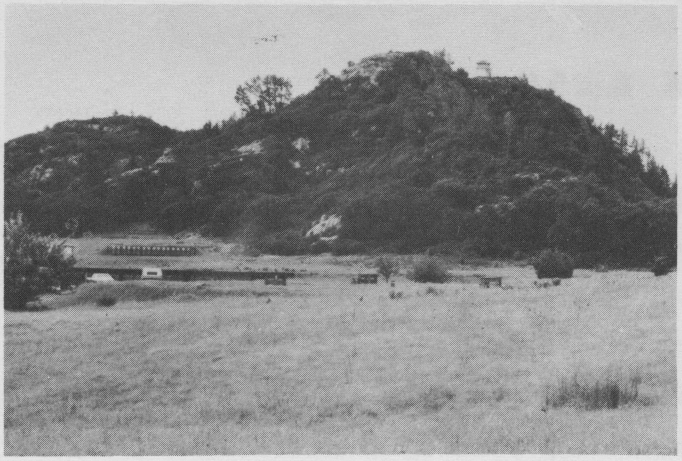
On the northern peak of Ben Lomond Mountain, Eagle Rock towers above any other point in the Waddell. Cliffs and bluffs separate the Rock from the lower areas that it commands, conveying an air of aloofness. The hard sandstone of the summit crag has been carved by winds, roots, and water into a strong sculpture of hollows and knobs.

Eagle Rock is at a strategic interface. To one side is the cultivated landscape of the flat plateau of the Locatelli ranchlands and the distant houses of the San Lorenzo Valley. On the other side, the wilder, forested countryside stretches across upper Scott Creek and into the Waddell.

Northwest from Eagle Rock, miles of heavily forested canyons and drier chaparral-covered ridges extend from the headwater country of Waddell, Boulder, and Scott Creeks to the upper watersheds of adjacent creeks. The cool, still Pacific, often screened by fog, makes a serene, softly arcing background. In contrast, the heavily populated San Lorenzo Valley to the east, the silver lookout tower atop the summit and the busy plateau just below vividly display the reach and impact of man's activity. The ridge thereby provides a quietly dramatic divide between two distant landscapes, one dominated by human and the other by non-human elements. This contrast is pronounced, defining the character and lending thought-provoking significance to the view from Eagle Rock.

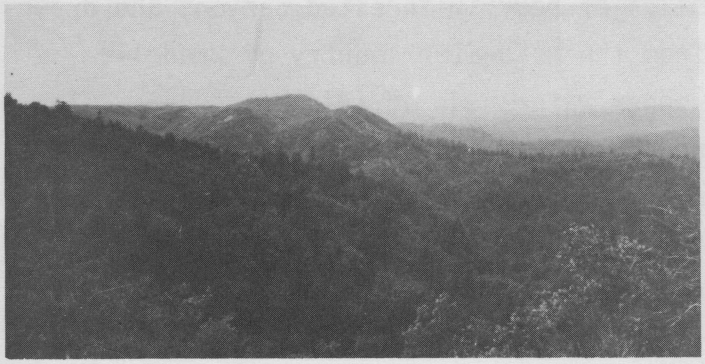
Although it is only a few acres in size, Eagle Rock supports a rich and diverse chaparral flora. About 30 species of shrubs flourish, whereas only half that many occur in the far more extensive chaparral of the Chalks region. A variety of flowering herbs also thrive in the Rock area. Some of the more noticeable are Indian warrior (Pedicularis densiflora), shooting star (Dodacatheon Hendersonii), stonecrop (Dudleya cymosa), Indian paintbrush (Castilleja foliolosa), red larkspur (Delphinium nudicaule), skullcap (Scultellaria antirrhinoides), and hog fennel (Lomatium dasycarpum).

Along the southern slope is a small grove of 60 rare Santa Cruz cypresses (Cypressus Abramsiana). These trees occur only in three other locations in the world, all within the Santa Cruz Mountains. Because of their limited distribution, these cypresses are often studied by botanists and biogeographers. They are in need of protection, since the sites of two of the four stands are projected for subdivision in the near future.



Eagle Rock as seen from Empire Grade

Pine Mountain from Eagle Rock



Grove of rare Santa Cruz Cypress

Garryea elliptica, an unusual shrub of the chaparral

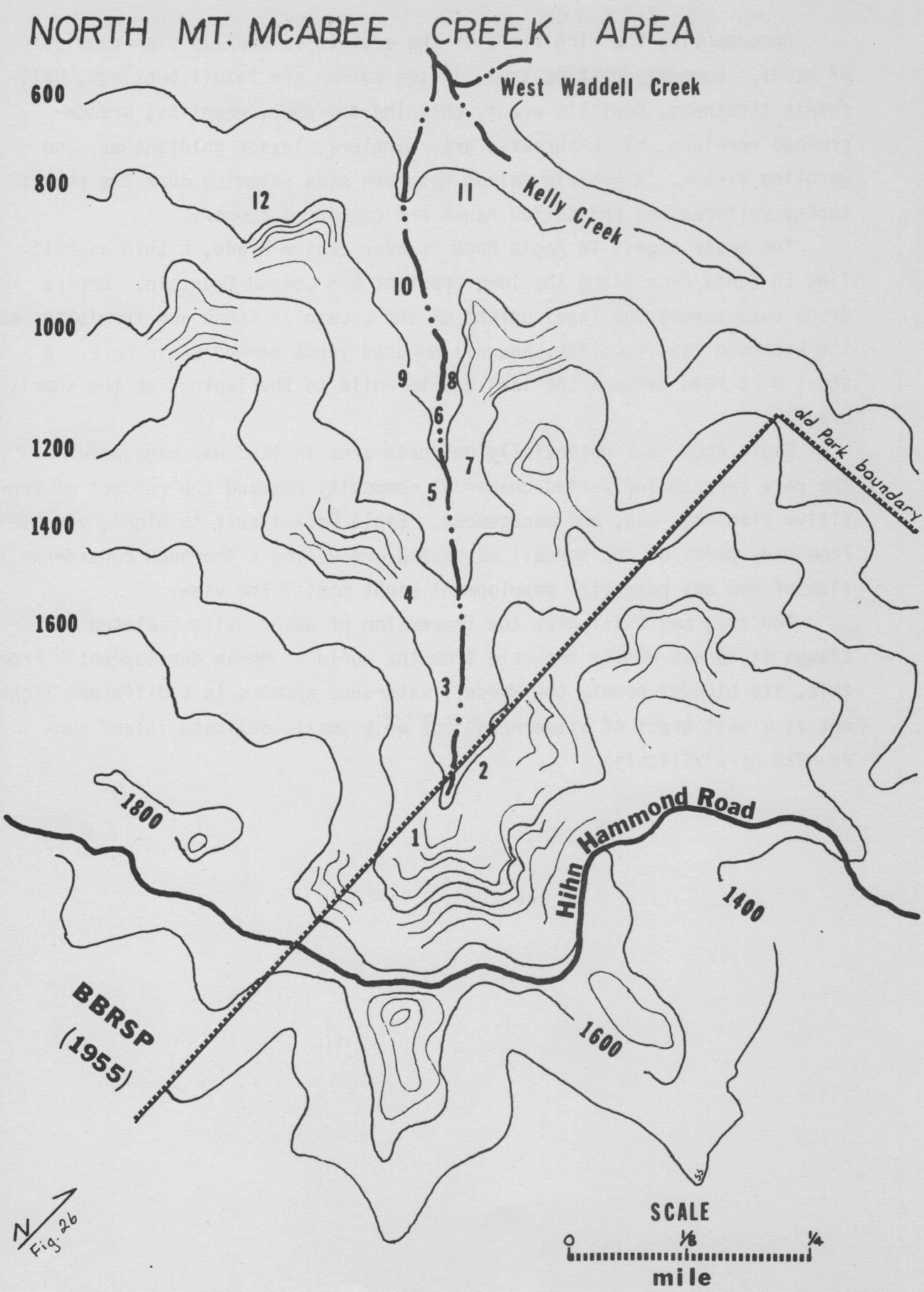
Sculptured Sandstone on the Top of Eagle Rock

Accompanying the rich flora of the area is an equally rich population of birds. Commonly nesting there in the summer are lazuli buntings, California thrashers, Bewick's wrens, chipping sparrows, wrentits, orange-crowned warblers, black-throated gray warblers, lesser goldfinches, and warbling vireos. A prairie falcon has been seen skimming over the rocks; turkey vultures and red-tailed hawks are common in summer.

The major access to Eagle Rock is over Empire Grade, a thin asphalt link to Santa Cruz along the long crest of Ben Lomond Mountain. Empire Grade cuts across the level upland of the Locatelli Ranch and terminates at the Lockheed Test Facility, several hundred yards beyond Eagle Rock. A short dirt road extends the last quarter-mile to the lookout on the summit crag.

Eagle Rock is a potentially delicate area in land use management. The rare cypress and varied chaparral community command the respect of sensitive planning, use, and management. Eagle Rock itself is highly visible from many parts of the Waddell watershed, requiring a thorough consideration of how any potential development might modify the view.

The crag can still give the impression of being quite isolated although it is not wholly separate from the world of human development. From this, its highest point, the Waddell watershed appears in a different light: not as a vast tract of wilderness, but as a small, delicate island surrounded by civilization.


NORTH MT. McABEE CREEK AREA
West Waddell Creek
Kelly Creek
old Park boundary
Hihn Hammond Road
BBRSP
(1955)
600
800
1000
1200
1400
1600
1800
1
2
3
4
5
6
7
8
9
10
11
12
N
Fig. 26
SCALE
0
1/8
1/4
mile

NORTH McABEE CREEK AREA

KEY TO MAP

1. juncus - soil creep
2. logging road - heavy erosion
3. upper springs - waterhole
4. Butano sandstone outcrops
5. torreyas (Calif. nutmeg)
6. lower springs - running water
7. succession of pools surrounded by moss and ferns
8. numerous pools and falls
9. unstable steep slopes
10. virgin redwoods
11. huckleberry - tan oak brush
12. heavily logged area

A sharp line cuts across the middle of the North McAbee Creek area, separating old-growth redwood and fir forests from lands that were heavily timbered about two decades ago. The line is a former boundary of the State Park, which now includes all of this small watershed. The contrast between the two sections is a clear reminder that parts of the Waddell are too steep or unstable for visitor uses that are appropriate elsewhere in the basin.

Extensive soil creep and sliding are substantially changing the appearance of the head of the creek, surrounded on three sides by heavily timbered steep slopes. Logging has accelerated the rate of erosion by disturbing the soil, increasing runoff, and encouraging gullying along cuts and skid trails. Annuals and small perennial herbs are most abundant, with colonizing woody shrubs, such as California lilac (Ceanothus thyrsiflorus) and coyote brush (Baccharis pilularis) scattered on the old road banks. Lack of deep-rooted vegetation has permitted the development of deep gullies, which may extend to adjacent areas if not checked.

Erosion on a Logging Road

The lower creek area is also characterized by very steep slopes, broken into steps by cliffs. The stream cuts into the sandstone

walls, forming little pools and falls surrounded by mosses, ferns, and lichens. Tan oaks and virgin redwoods enclose the narrow canyon and help stabilize the slopes. Developed trails along this short gorge may upset its precarious balance, possibly initiating sliding and erosion similar to what is seen in the upper creek area. Easier access would also further endanger the vegetation and the serenity of the pools. Since this area is highly sensitive compared with other areas of the Waddell, great care is necessary to preserve its integrity. Man's presence should be minimal and the entire drainage area should be by-passed by any major pathway network.

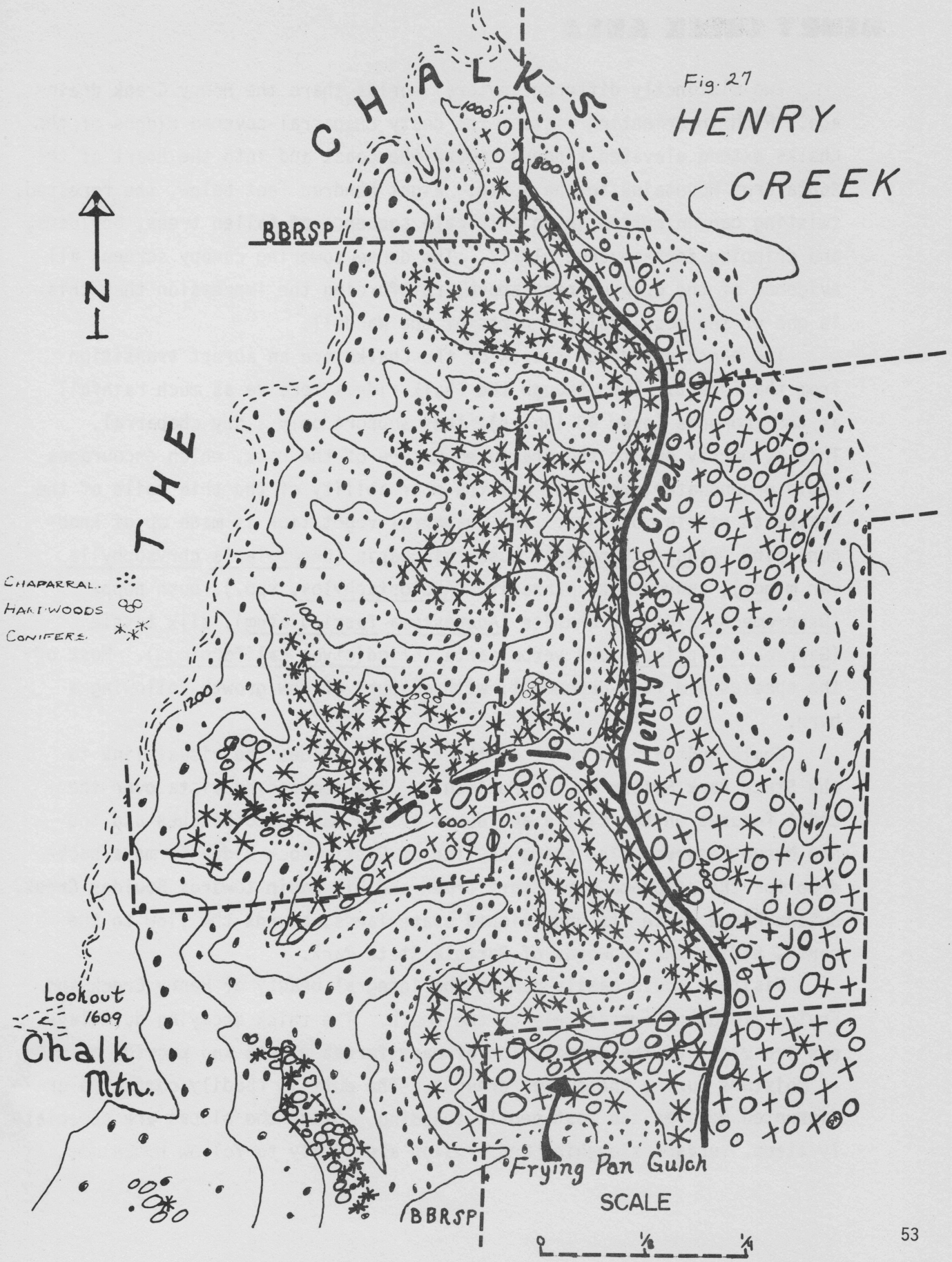


Fig. 27
HENRY CREEK
THE CHALKS
N
BBRSP
Henry Creek
CHAPARRAL
HARDWOODS
CONIFERS
1200
1000
800
600
Lookout
1609
Chalk Mtn.
Frying Pan Gulch
BBRSP
SCALE
0
1/8
1/4

HENRY CREEK AREA

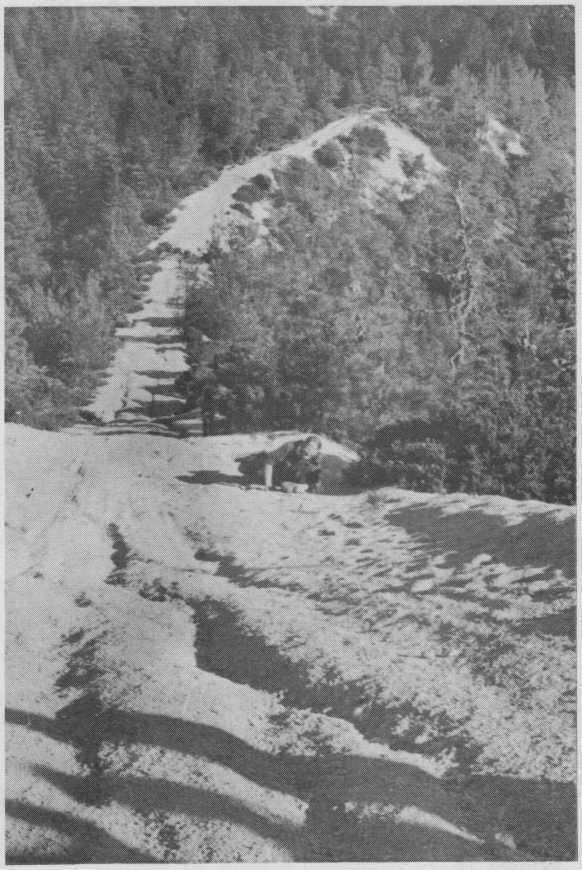
Two distinctly different natural worlds share the Henry Creek drainage. Rich in orienting vistas, the dusty chaparral-covered ridges of the Chalks extend elevated fingers toward the coast and into the heart of the Santa Cruz Mountains to the north. Eight hundred feet below, the forested, twisting canyon bottom is an intricate sequence of fallen trees, boulders, and dripping fern-covered cliffs. The dense towering canopy screens all evidence of the open country above, reinforcing the impression that this is one of the most isolated parts of the Waddell.

The harsh dry upper slopes of the Chalks are an abrupt transition from the forest. Even though the Chalk ridges receive as much rainfall as the redwoods (over 40 inches), they support only a dry chaparral. This is partly due to the fractured nature of the rock, which encourages rapid groundwater drainage, and the poor ability of the thin soils of the Chalks to retain moisture. The chaparral vegetation is made up of knobcone pine (Pinus attenuata), bush chinquapin (Chrysolepis chrysophylla var minor), canyon oak, manzanita (Arctostaphylos, spp.), bush poppy (Dendromecon rigida), chamise (Adenostoma fasciculatum), silk tassle (Garryea elliptica), and yerba santa (Eriodictyon californicum). Most of the species are fire-dependent, with a spurt of new growth following a burn.

Chalk Mountain, a point on the ridge, provides the visual link to the State Park System on the Peninsula. The commanding vista over the coast focuses on the cliffs and dunes of the San Mateo beaches and the Ano Nuevo Reserve. The sharp skyline of Castle Rock Ridge forms a backdrop for the panorama over Henry Creek and Big Basin towards Boulder Creek. Butano Ridge, with its undeveloped state lands, bounds the view to the north, hiding the redwoods of Portola State Park.

Visitors could easily damage the integral beauty of Henry Creek and Frying Pan Gulch immediately to the south. The thick decaying duff layers are vital to the germination of many forest plants and provide a store of moisture during the summer drought. The duff is readily compacted or disrupted by even the most gentle treading. Since the slopes are especially steep, surface sloughing and erosion are likely to follow human use.

The Chalks, because of the fractured rock and special structure of the soil, include the most fragile soil and vegetation associations in the Henry Creek watershed. Trail bikes, harsh visitors to the Chalk ridges, leave lasting scars. The area is highly sensitive to the action of slides, which uproot and shear off the plants. Once the vegetation has been damaged and can no longer stabilize the slope, erosion carries away what little soil may have been formed. Soil development then begins anew on the bare rock and may require hundreds of years to reach maturity. Revegetation is slow under the harsh edaphic conditions.

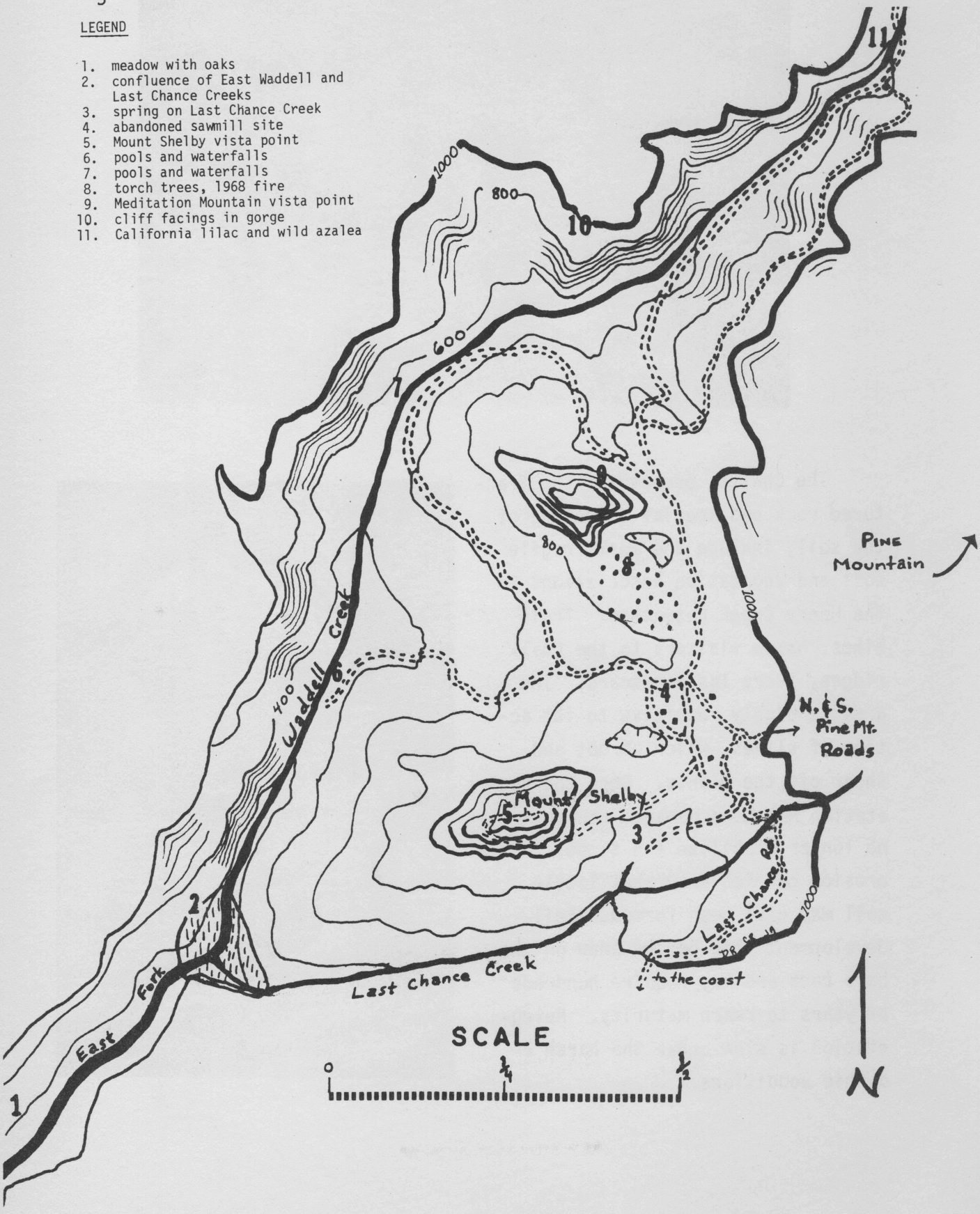


EAST WADDELL GORGE

Fig. 28

LEGEND

1. meadow with oaks
2. confluence of East Waddell and Last Chance Creeks
3. spring on Last Chance Creek
4. abandoned sawmill site
5. Mount Shelby vista point
6. pools and waterfalls
7. pools and waterfalls
8. torch trees, 1968 fire
9. Meditation Mountain vista point
10. cliff facings in gorge
11. California lilac and wild azalea

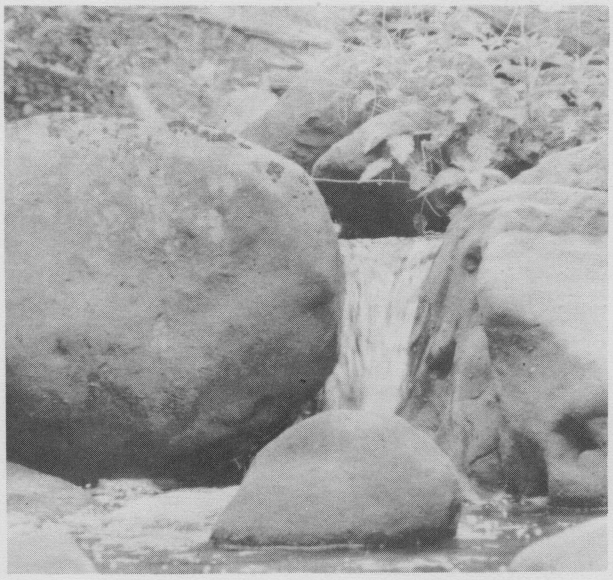


EAST WADDELL GORGE AREA

Through the meeting of rock and water, the East Waddell gorge shows the processes of its formation. The force of the water cutting downward can barely keep pace with the uplifting earth.

The creek begins in Big Basin, flowing quietly and giving only hints of its power to shape rock. Passing into the gorge, the water cuts deeply into solid sandstone. Narrow rock-faced walls rise above series of waterfalls, cold pools, and boulder-choked passages while the water wears away the land. As the mountains recede, the East Waddell calms and meets with Last Chance Creek. The slow-spoken flow continues onward to the West Waddell.

History is important in the East Waddell; logging roads and people have physically and intangibly opened up the land. Above the gorge, remains of logging days--a rusty burner, an abandoned warehouse, and decaying cabins--are abiding reminders of man's presence. However, the clearing around the mill site is more subtle than a scar of logging destruction--it is a human niche in the land. It is a relief in the intensity of nature and a physical and human point of orientation. Many visitors welcome this landmark as a recognizable link between city and wilderness. To those more familiar with the area, it is a land at the crossroads between the restraints



of increased settlement and remaining open for the wandering visitor.

The East Waddell contains special private places, but theirs is a privacy threatened by encroaching development and overcrowding. Threatened areas include Last Chance Creek, to its confluence with the East Waddell; the East Waddell streambed, especially where accessible from the road; and Mount Shelby and Meditation Mountain. Enjoyment of the values and beauties of the East Waddell is in sharply inverse relation to the amount of development and the number of people visiting or living in the area.

Many values can withstand the pressures of use to a limited extent:

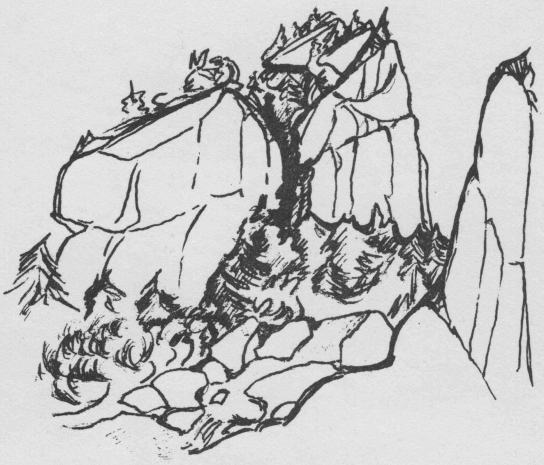
Seasonal diversity:
- alders in winter and fall--orange and bare white
- rainy days
- wintertime and night hiking
- wildflowers
- long summer days
- foggy times, when the cliff facings become a Chinese landscape painting
- night times
- a good chance of sunshine and brightness

The smells of the land: flowers and plants; rain and wet earth; heat and coolness; sunshine

Times for adventure and feeling healthy: traveling in the creek bed; rock scrambling and climbing; swimming in the ponds

Experiencing the gorge: the certain awareness of being "within"

Other values of this area have a much lower tolerance level:



Privacy and seclusion--the specialness of being alone and close

Natural sounds and quiet

Learning values and beauties of an undisrupted area

Peacefulness at evening time

Room for true exploration

Leaving reborn for tomorrow: the evolution of relaxation

IMPACTS ON AMENITIES OF THE EAST FORK FROM PRIVATE AND PARK USES

Fig. 28a

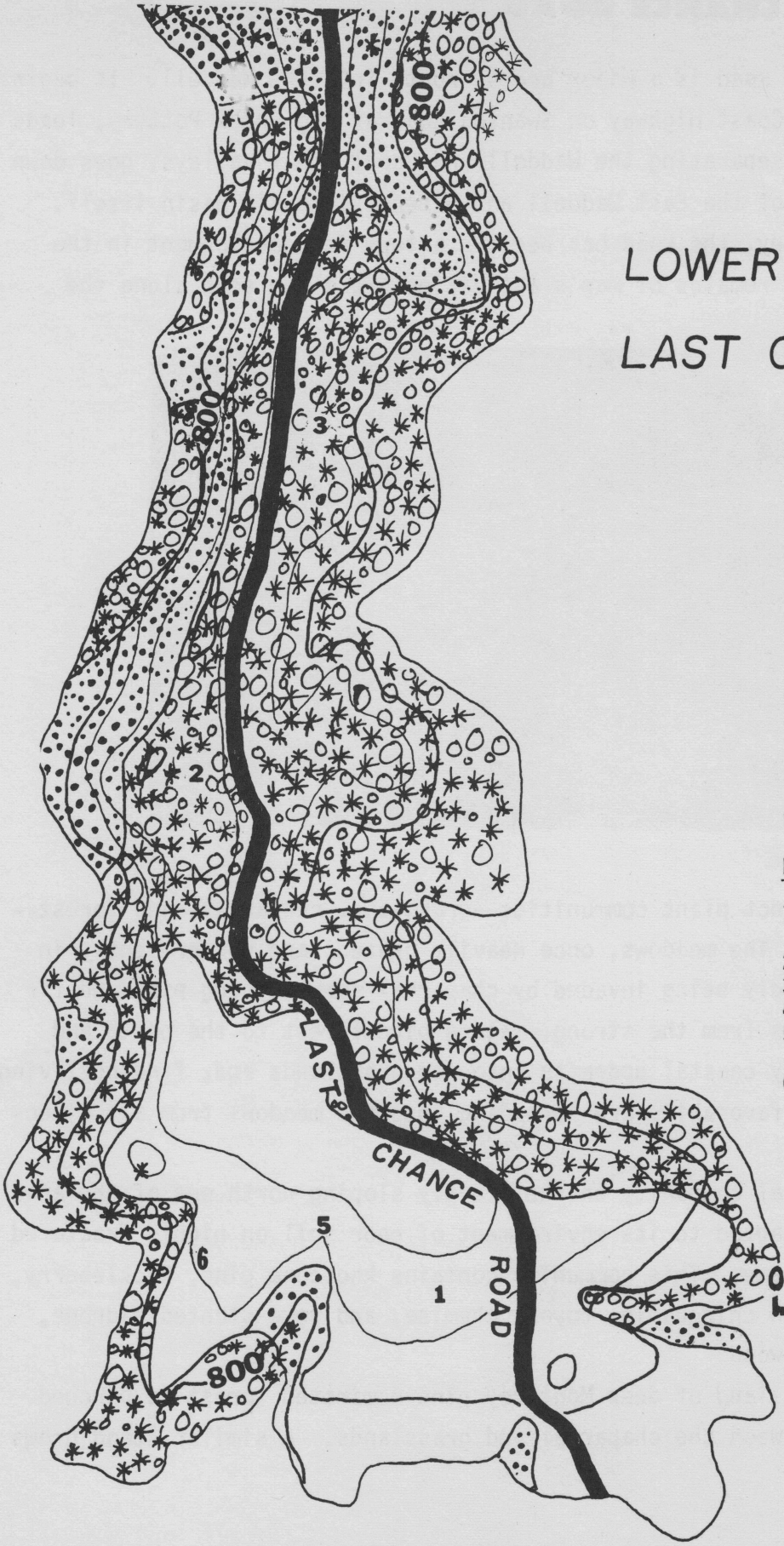
	VISTA POINTS: MOUNT SHELBY AND MEDITATION MOUNTAIN	SOCIAL SPACES	LAST CHANCE CREEK	CLIFF FACES	UNIQUE GEOLOGIC FEATURES	WATERFALLS, PONDS, BOULDERS, AND HUCK FINN ISLAND	UNIQUE VEGETATION	UNIQUE FAUNA	ANIMAL HABITATS
EXCLUSION OF NATURAL FIRE		●	●				●	●	●
SOIL COMPACTION		●	●						●
INDUCED EROSION		●			●				●
INTRODUCTION OF FAUNA, FLORA	●	●	●	●		●	●	●	●
LOSS OF NATURAL FAUNA, FLORA	●	●	●	●	●	●	●	●	●
BULLDOZING	●		●	●	●	●	●	●	●
CLEARING	●	●		●	●	●	●	●	●
LOGGING	●	●	●	●		●	●		●
PONDING			●			●			●
USE OF ROADS AND TRAILS	●	●	●	●	●	●	●	●	●
CROSS COUNTRY HIKING		●	●	●	●	●	●	●	●
FISHING AND HUNTING		●	●			●	●	●	●
HORSEBACK RIDING		●	●					●	●
QUIET RECREATION		●				●	●		●
INCREASE IN RESIDENTIAL AND VISITOR USE	●	●	●	●	●	●	●	●	●
TRAFFIC AND OVERFLIGHTS	●	●	●			●		●	●
CAMPING AND PICNIC FACILITIES		●	●			●	●	●	●
SETTLEMENT AND VISITOR NOISE	●	●	●	●	●	●		●	
GARBAGE			●			●	●	●	
SEWAGE DISPOSAL PROBLEMS		●	●				●	●	
FIRE HAZARDS		●	●				●	●	●
VANDALISM			●	●		●	●	●	●
DUST		●							

NOTES EXPANDING MATRIX

1. The variety of ground plants indicative of Last Chance Creek's specialness includes yerba buena; hedge nettle; deer fern; golden-back, five-finger, maidenhair, and wood ferns; bracken, chain and Dudley's shield fern; thimbleberry; blackberry; vetch, whipplea; wild iris; false Solomon's seal; wild rose; fetid adder's tongue; crows-foot; and redwood seedlings.

2. Geologic features include cliff portals on lower East Waddell Creek; honeycomb weathering along Last Chance Road and above the creek bed; and exposed concretions, boulder beds, and faults.

3. According to members of the School of the Earth community, who live in the area, fauna include the red-tailed hawk; turkey vulture; coyote; bobcat; deer; rainbow trout; rubber boa snake; rattlesnake; and rough-skinned newt.



LOWER LAST CHANCE ROAD

Fig. 29

LEGEND

1. grasslands, with vistas in three directions
2. Monterey pine forest
3. mixed forest
4. chaparral
5. old barn and abandoned structures
6. pine forest invading grasslands

SCALE

0 1/8 1/4

mile

N

LOWER LAST CHANCE ROAD

Last Chance Road is a major access route into the Waddell. It begins a mile from the Coast Highway on Swanton Road at Big Creek Pottery, leads along the ridge separating the Waddell and Scott Creek valleys, goes down into the canyon of the East Waddell and extends into Big Basin itself. For over a century, the road has been an artery for development in the Waddell; and the remains of man's activities are often seen along the route.

Three distinct plant communities--grassland, chaparral, and forest--are noticeable. The meadows, once heavily grazed, are not presently in use and are rapidly being invaded by chaparral scrub, young pine and fir trees. Seedlings from the strong, mature pine forest to the north and west are borne by coastal updrafts into the grasslands and, finding living conditions very favorable, are spreading into the meadows from all directions.

The chaparral community on the steeply sloping north end of the area is especially adapted to its environment of poor soil on highly fractured Santa Cruz mudstone. This community contains knobcone pine, huckleberry, manzanita, golden chinquapin, toyon, chamise, and some stunted madrone, tan oak, and redwood.

A curious island of deep Monterey pine-dominated forest is perched on the ridge between the chaparral and grasslands. A similar stand grows

on the opposite ridge across Waddell Creek, making these the only coastal headlands with a native forest between Santa Cruz and Half Moon Bay.

Fine vistas overlooking Scott Creek and Waddell Creek valleys open from this shelf atop the ridge. Coastal landmarks, such as Ano Nuevo Point and Greyhound Rock, are silhouetted far below; rolling meadows with scattered oaks contrast with the grey sea. These images are enhanced by the sound and sensation of the soft coastal breezes. The airy feeling of the high meadows invites wandering and running about, exploring the weathered structures left by departed ranchers, looking for wildflowers, or relaxing under the Monterey pines on the soft, carpeted floor of the forest.

If a major visitor facility near the coast is deemed necessary, the southern portion of Lower Last Chance Road area should be considered. With careful planning and development, the area could provide an exciting and enjoyable setting for public use with a minimum of additional environmental impact. Although much of the area has recently been carved into haphazard 2 1/2-acre homesites, only one small dome structure has been built; there is still some hope that all of the land could be acquired for public use. The meadows seem durable enough to withstand heavy use as a picnic area and campground; in fact, the meadows are a relic of intensive human use. The area could well serve as a starting point for walk-in trips to remote campsites, to the Waddell valley, and to the coastal strand below.

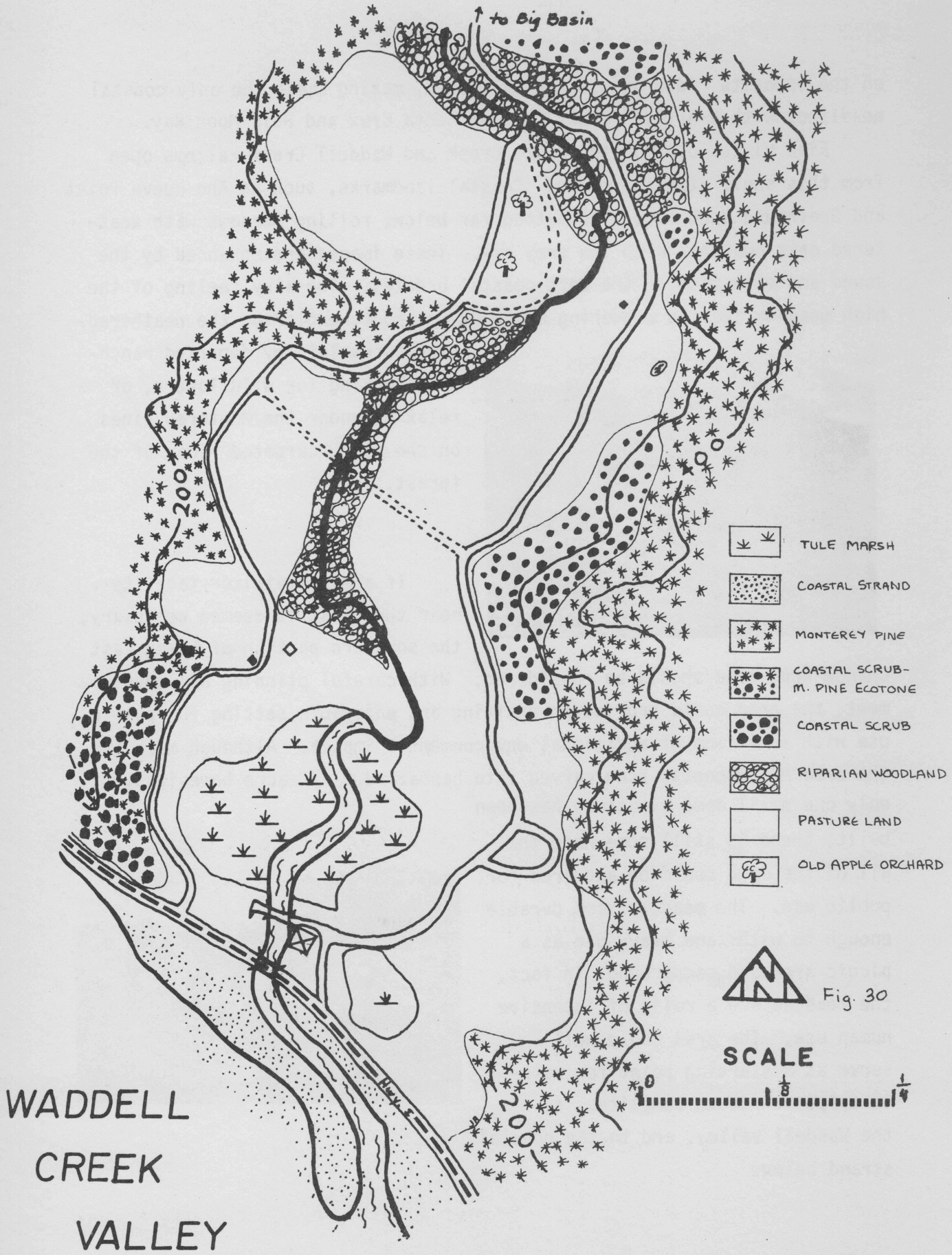


Fig. 30

WADDELL CREEK VALLEY

LOWER WADDELL CREEK VALLEY

The bottomlands of the lower Waddell valley extend approximately one mile upstream from the beach. The redwood-Douglas fir forest of the upper valley becomes fields and pasture land here, and the streamside growth is dominated by willows instead of alders. The stream itself courses through the valley, broadens into a marsh, and finally empties through a fish weir into a salt-water lagoon. Here, the steep slopes sheltering the open valley are covered with the smooth deep green of Monterey pine. This stand is the northernmost of the four remaining natural forests in the world. It therefore affords scientists a special opportunity for study.

The freshwater marsh, one of the most fascinating features of this area, is ever-changing; the physical and biotic processes within it are readily observable. Winter rains swell the marsh, but by early summer, only the irregular traces of olive rushes mark the winter boundaries. The marsh's animal community also responds to seasonal rhythms. The most conspicuous fluctuation is in the kinds of birds in the area.

The winter marsh is a welcome resting place for many migrating waterfowl and shorebirds and a winter home for some. The small flocks of green-winged teal and common goldeneye visiting from the far north mingle with year-round residents such as the great blue herons, mallards, coots, and cinnamon teals. The population of flying insects around the marsh is kept in check partly by a large contingent of black phoebes. A steady stream of occasional visitors rest and feed in this freshwater haven throughout the winter and into the spring.

The shrinking springtime marsh is also an inviting stopover spot for a number of migrating species, including such interesting birds as the greater yellowlegs and the northern phalarope on their way to the Arctic tundra. A surge of hatching insects coincides with the return of the swallows, some in migration and some coming to nest on the old buildings behind the marsh. The swallows replace the black phoebe as the dominant insect-catchers. Perhaps the most obvious symbol of the spring is the red-winged blackbird, whose distinctive voice and brilliant shoulder patches make him the most prominent resident of the springtime marsh.

Less obvious and more permanent members of the marsh and its environs include the black-tailed deer, who are frequent visitors to the small pastures bordering the marsh, and the brush rabbit, a resident of the neighbor-

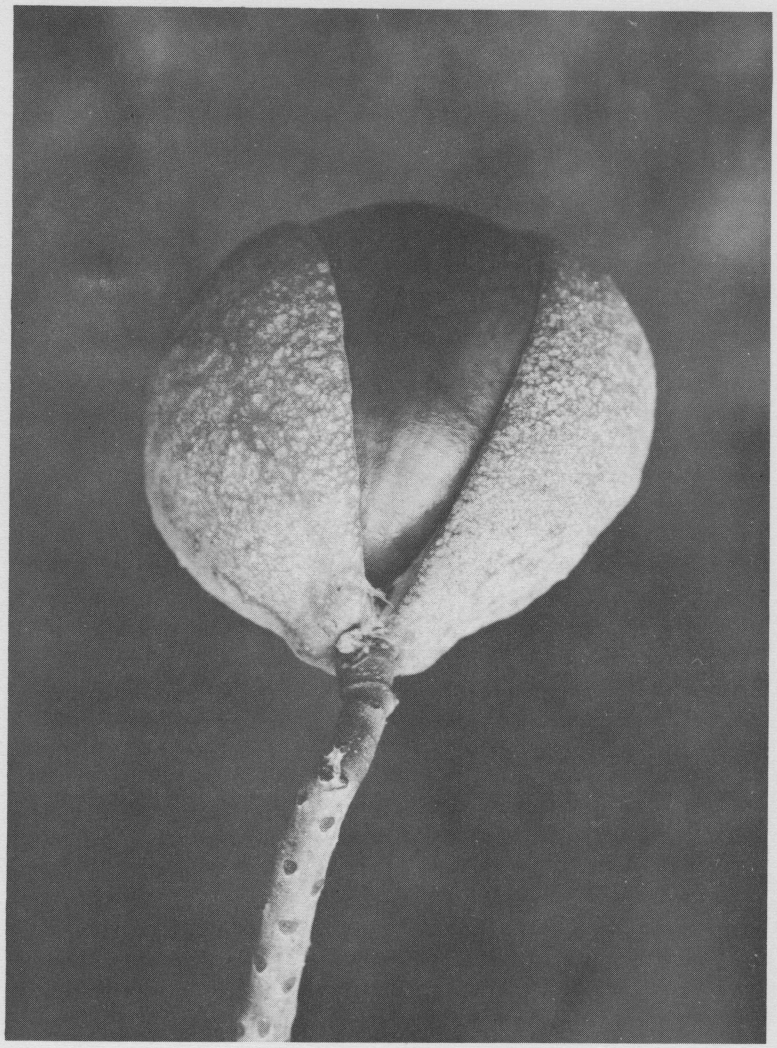
ing coastal scrub. Gold and green Pacific treefrogs and terrestrial, western aquatic, and common garter snakes are common. Occasionally, spotted skunks can be seen on the dunes at night; and the soft mud around the stream and marsh records the visits of bobcats, coyotes, and even foxes - clear indications of an abundant nocturnal activity that man does not normally see. An even more secretive inhabitant of the marsh and the tule pond is the Western pond turtle.

Two dirt roads comprise the access to the upper Waddell valley and to the Willis and McLean residences, eventually joining at the second bridge. If the valley were incorporated into the park, increased vehicular or foot traffic along the west road could have severe disruptive effects on the wildlife community of the marsh. Wintering and migratory waterfowl are particularly sensitive to disturbance and cannot be approached closely without being frightened into flight. People using these roads as access to picnic grounds farther inland would make the marsh uninhabitable for many species of waterfowl. The Waddell marsh is one of the few relatively undisturbed bodies of fresh water left along the coast. As such, its importance in the life of many migratory waterfowl and shorebirds grows each year as development spreads along the shoreline.

In the lower valley, ranch-buildings and their immediate surroundings have been settled by an assortment of creatures, ranging from black widow spiders to bats and including snakes, lizards, mice, barn swallows, cliff swallows, house finches, and a barn owl. Farther up the valley are several pastures and an old apple orchard. The pastures, composed primarily of European annuals, are now being grazed by a small herd

of cattle and uninvited deer. The spacious, pastoral nature of these grasslands is dependent on grazing; otherwise, a tangle of low shrubs from the bordering coastal scrub would soon take over.

Winter View of Marsh



PROBLEMS OF LAND MANAGEMENT

MAN'S IMPACT ON THE LAND

The Waddell has been a home, an economic resource, and a resort for many years. Man has worked in this richly diverse environment, supplying his needs from it. In the process, part of the land has been shifted toward a new, productive, homeostatic state: for example, grazing keeps the grasslands open. But more often, man's search for a "better" life has resulted in environmental disturbances that defy the ecosystem's limits of adaptation. Notably, heavy machinery has given man capabilities to alter the forests and slopes of the Waddell that perhaps out-distance his intentions.

In this chapter, we look at the man-induced changes in the landscape from the perspective of the natural systems: the physical earth, its waters, and the life they support. In the following companion chapter on conflicting uses, man's powerful interaction with the parkscape is considered in a problem-oriented, management framework. Our hope is that together these two approaches to the Waddell may lend insight into problems that arise in searching for a successful and evolving man-earth balance.

IMPACTS ON GEOLOGIC SYSTEMS

Cutting roads and trails, logging, construction, burning, and grazing may damage or destroy vegetation and often erode the vital topsoil. In the Waddell, many roads built as recently as the 1950s are now impassable, blocked by slides, slumps, and gullies. Bulldozed cuts into steep slopes throughout the drainage are likely to induce slides, particularly where these geologically unstable conditions already exist:

1. Slopes mantled by natural landslides, with unconsolidated material
2. Slopes underlain by shaly bedrock dipping downhill
3. Slopes underlain by extensively fractured or thoroughly weathered rock

Abundant examples include roadcuts on the southwest slopes of Pine Mountain, near the old sawmill, and on the northwest slopes of Mount McAbee, just above the Berry Creek Falls trail (see Figs. 5,6, and 7 in Geologic Processes).

Improperly logged forestlands become eroded and introduce a surfeit of sediment and debris into the streams. The upper part of West Berry Creek

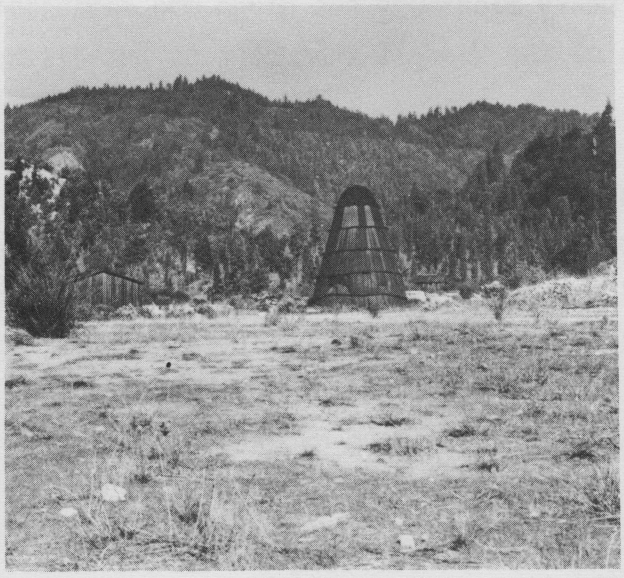


Fig. 31A Abandoned millsite in the East Waddell valley

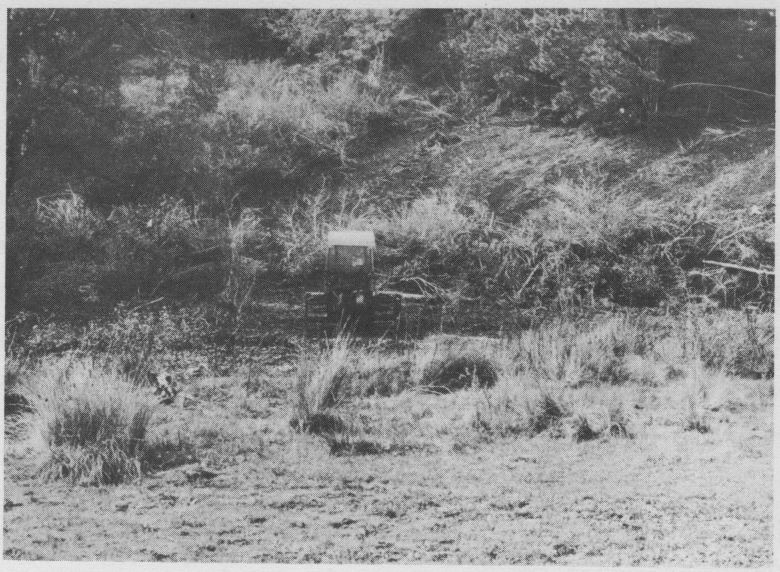


Fig. 31B Trees and brush being removed by a bulldozer. This area, situated on the ridge dividing Waddell and Scott Basins, is apparently being cleared for housing sites. The bare slopes in the background are likely to erode if not quickly seeded.

and portions of the northwest slopes of Mount McAbee, both logged in the 1960s, are already in the early stages of serious erosion. Logging in the 1950s initiated many of the deeper, now impassable gullies on the old Miller property along the East Fork.

IMPACTS ON HYDROLOGIC SYSTEMS

Sediment added from road construction and logging alters the stream environment, with both beneficial and harmful effects. Riparian vegetation thrives on the floodplain soils built from stream deposits, and is adapted to periodic flooding. However, siltation can harm fish reproduction by covering the gravel in which the fish lay their eggs and thereby suffocating the embryos. Some of the added sediment is deposited in the marsh, which is now isolated from the flushing action of tidal currents by a fish weir. The combination of increased sedimentation and diminished tidal scour are likely to speed the filling of this key environment. This could

possibly lower the fish populations, which have remained relatively stable over the past 50 years (McLean, oral communication).

Water pollution is one diagnostic index of man's impact on the environment. Bacteria enter water principally in sewage and eroded soil and render the water a potential source of diseases. For example, in the early part of this century, cases of polio and typhoid in the lower reaches of the Waddell were attributed to drinking water contaminated by the discharge of raw sewage into the East Waddell from Big Basin Park (McLean, 1971, p.4).

Currently, there is no practical way to test directly for disease organisms, so sanitarians generally test for the presence of coliforms, an acceptable indicator of fecal pollution. Fecal streptococci are also present in sewage-contaminated water. In fresh water, streptococci do not live as long as coliforms and thus indicate more recent pollution. For water contact sports, the Santa Cruz County Health Department has set a maximum safe limit of 200 fecal coliforms per 100 ml. of water. Almost every test we made in the Waddell showed that the water meets these limits (see Technical Appendix). However, with the exception of some samples taken from the springs, the water does not meet the accepted requirements for untreated drinking water (4 fecal coliforms per 100 ml.).

Relatively high counts of fecal coliform and streptococci were found in the Bloom's Creek upper tributaries, which lie outside the park. This condition is probably caused by seepage of effluents from perhaps a dozen houses into the streams. The lower portions of Bloom's Creek flowing in the park show less contamination. The count rises, however, as the creek passes through the campgrounds.

The headwaters of Opal Creek lie within or very near the park boundaries, where there is no visible building or camping. Bacteria counts are very low near the stream's source and slowly increase downstream. Coliform concentrations rise dramatically near the campgrounds.

The park operates a secondary treatment sewage plant which discharges its effluents into the East Waddell just below the confluence of Bloom's and Opal Creeks. Our tests were made above and below that outfall. Paradoxically, the bacteria counts downstream from the discharge were always lower than those upstream. This is probably explained by the presence of chlorine used in treating the sewage. The residual amounts of chlorine

Fig. 32A Big Basin State Park Sewage Treatment Facility

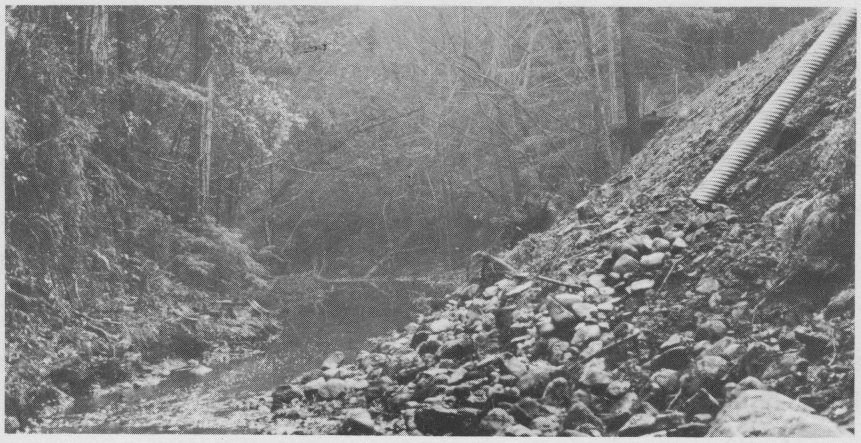


Fig. 32B Outfall into the East Waddell. At times suds are apparent in the water at the point of discharge.

vary. At times, the discharge has a strong chlorine odor; at other times, it cannot be sensed. On February 28, a drastic reduction from 95 to 0 fecal coliforms per 100 ml. was noted. It appears that the residual chlorine is sometimes so strong that it virtually "sterilizes" the creek's water, harming beneficial aquatic life.

Sewage adds a large and variable supply of nutrients to the waters of the East Waddell, which may have a very substantial effect on the living

organisms in the stream. In winter, the high concentrations of phosphates and nitrates in the effluent are readily diluted by the greater quantity of creek water. However, more tests are needed during the summer to determine how well the concentrations are diluted when there is the least amount of stream water and the highest sewage flow.

More algae and other aquatic plants are noted below the sewage plant than above, but the exact reason for this remains unclear. Three factors may be important: sunlight, nutrients, and geology. Shade prevails throughout the year in the virgin redwood forest above the treatment plant. But the land downstream from the sewage plant is presently or has been privately owned and has been logged or burned. Young alders and a few maples grow beside the creek here. During the fall and winter, when these deciduous trees have no leaves, life-giving sunlight can penetrate to the creek. Nutrients are supplied by the sewage effluent and are also possibly leached from logged areas, which are more susceptible to erosion. Finally, since the sewage facility is located on the Ben Lomond Fault, the rock and soil types upstream differ from those downstream. Therefore, the kind and amount of minerals and bed materials washed into the creek varies.

The concentrations of bacteria in the East Waddell decrease downstream from the sewage plant and, for that matter, from the lower end of the campgrounds. However, the bacterial concentrations in the undeveloped West Waddell also decrease towards the mouth. This may indicate that downstream the creek is being charged with groundwater, which increases its volume of discharge and dilutes the concentrations of bacteria. Tests show that the concentration of bacteria may increase again in the Waddell before it reaches the marsh, probably because of cattle grazing on the ranch lands.

IMPACTS ON BIOLOGIC SYSTEMS

FIRE

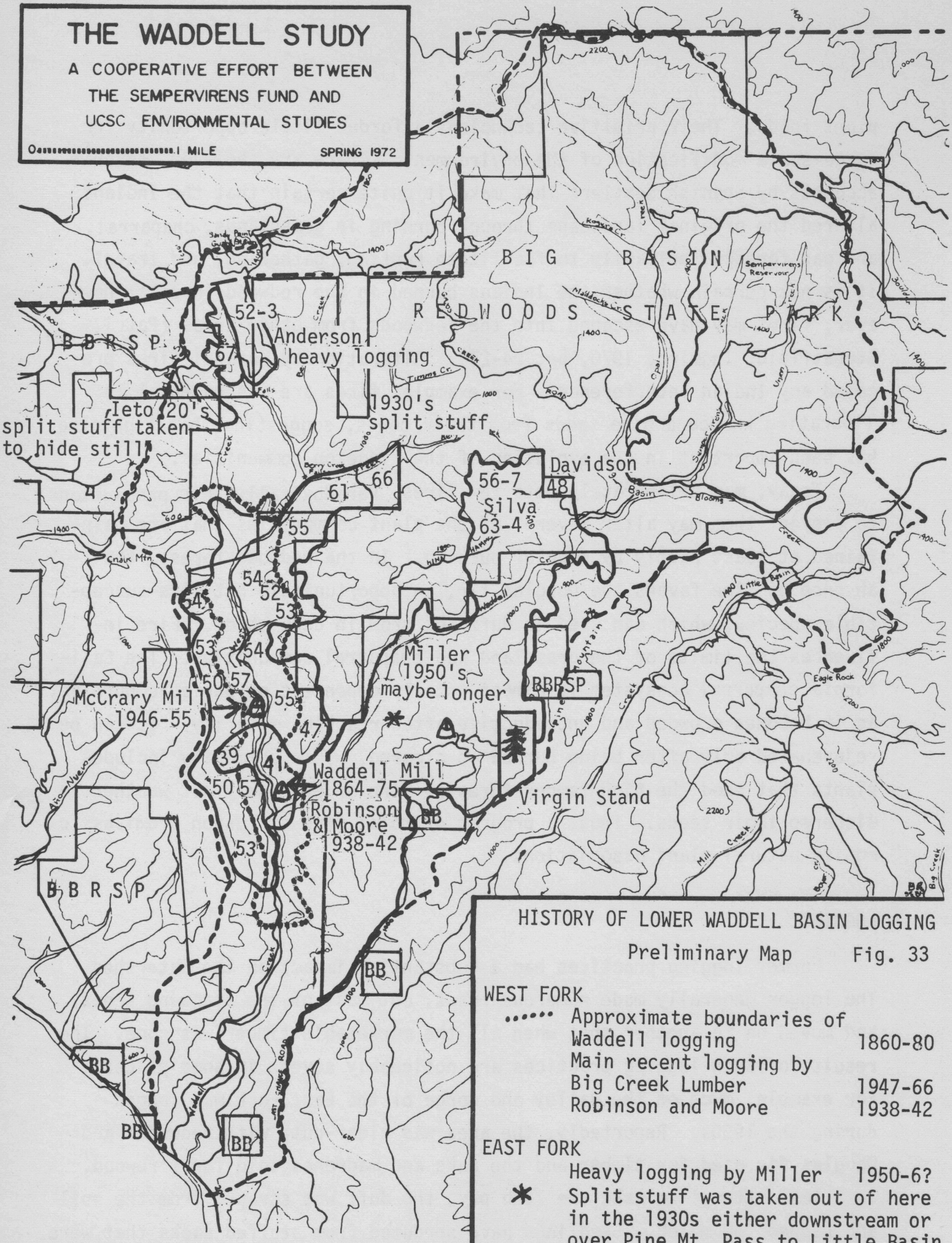
As mentioned in the discussion of history, the first human alteration of the Santa Cruz Mountain ecosystem was made by Indians, such as the Coastanoans, whose life revolved around fishing, hunting, and gathering

plant foods. Their primitive technology afforded little opportunity for large-scale modification of the environment. There are, however, several accounts by Spanish settlers that make it quite certain that the Indians altered the original landscape through burning in grasslands, chaparral, and oak forests, primarily to facilitate hunting, gathering, and travel. It is not certain whether the Indians burned in the redwood forests; however, fires may have escaped into the redwoods from other areas (Patri, Streatfield, Ingmire; 1970, pp. 24-27). Alteration by natural fires preceded any Indian interference. For example, fires are instrumental in liberating knobcone pine seeds from their cones, suggesting that lightning has been important in the evolution of the ridgetop communities.

Today, man deliberately sets few fires. Paradoxically, his precautions to prevent them may alter several of the plant communities that are maintained at least partly by regular burning. In the redwood forest, the absence of fire favors the Douglas fir, an opportunistic but fire-susceptible species, which can seed in duff and grow in deep shade. Fire influences the limits of the grassland and chaparral communities. The California chaparral ecosystem is almost totally dependent on periodic burning, as it becomes crowded and unproductive after reaching maturity. It can be rejuvenated only after being burned or cleared. This community includes plants that need the high temperatures of fire or extremely hot weather to disperse their seeds. Thus, a program of total fire exclusion promises to modify natural plant associations.

LOGGING

Former logging practices had a substantial impact on the watershed. The logger generally made numerous roads, cut most of the standing trees, and moved on to another spot when all the marketable timber was gone. The results of such logging practices are noticeably severe in some places. For example, much of the valley and gorge of the East Fork was logged during the 1950s. Reportedly, the area was clear-cut, with redwoods and Douglas fir used for timber and the oaks and madrones sold for firewood. In a last attempt to make the land pay, the duff was scraped from the soil and bagged for mulch. Seedlings have sprouted from stuffed sacks that were



HISTORY OF LOWER WADDELL BASIN LOGGING

Preliminary Map Fig. 33

WEST FORK

..... Approximate boundaries of Waddell logging 1860-80

Main recent logging by
Big Creek Lumber 1947-66
Robinson and Moore 1938-42

EAST FORK

* Heavy logging by Miller 1950-6?
Split stuff was taken out of here in the 1930s either downstream or over Pine Mt. Pass to Little Basin and out the San Lorenzo Valley by railroad.

20s,...60 Years logging took place in 1900s.

Based on interview with Bud McCrary of Big Creek Lumber (Spring 72); checked with 63 & 68 air photos.

left behind. As was common in the industry, logging roads mounted the steepest slopes bulldozers could climb, often cutting severe grades into the hillside. Many of the roads in the East Waddell valley are heavily eroded, with gullies sometimes 4 to 6 feet deep, undercutting the root system of adjacent trees. This is also noticeable in many other parts of the watershed.

The East Waddell area has been slow to recover. Vegetation on the old logging roads and clear-cut slopes is commonly still in the first stages of succession. Since a large amount of soil, along with necessary nutrients, has eroded away, many plants find it impossible to thrive here. However, plants that are aided by nitrogen-fixing bacteria are favored in this altered environment. These include wild lilac, Scotch broom, and Douglas fir.

Elsewhere in the drainage, logging generally took place at an earlier date, and the forests often shows healthy signs of recovery. Many of the owners and custodians of the land take a great interest in careful husbandry, encouraging hopes for a conserved future landscape.

During the past few years, logging practices have been substantially revised. Very little timbering has taken place in the Waddell under the new guidelines. However, estimates of impact on the environment could be made on the basis of careful observation of the 1972 selective logging in upper Scott Creek and at nearby tree farms in San Mateo County.

MAINTAINED PASTURES

Man maintains pasturelands through fire, grazing, and herbicides, thereby halting the encroachment by brush and trees from the perimeter. The pasture environments favor introduced plants, which are better adapted to grazing pressures than the native plant species. The valley floor and the lower grasslands near Last Chance Road are examples of this altered landscape.

MAN AND BIRD

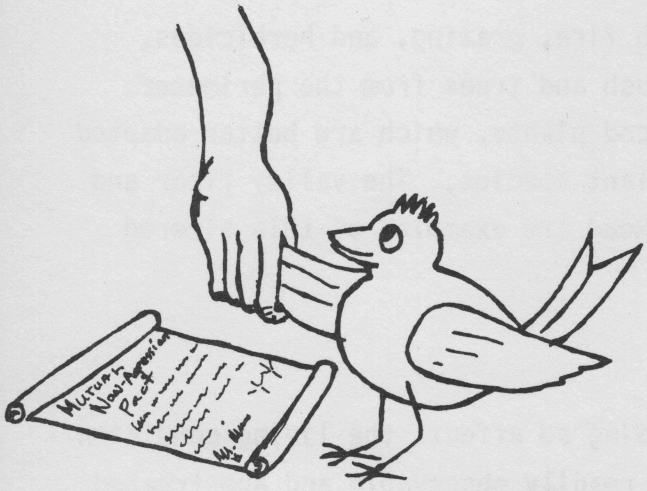
Man alters the landscape and in doing so affects the living condition of wildlife. The effects on birds are readily observable and are treated

here in depth since man's impact on avian communities can be considered representative of his impact on wildlife in general.

Human activity influences the birds of Waddell by changing the character of habitats, altering the amount of food available, and modifying predator populations. These activities include logging throughout much of the Waddell, clearing of brush and forest for pasture and farm land, grazing, manipulation of fire, construction of buildings, roads, and camp facilities, damming the mouth of Waddell Creek, and the many park and recreation uses.

Habitats are usually not destroyed, just changed. Logging redwoods, for example, reduces the nesting, perching, and feeding habitats of such birds as the brown creeper and olive-sided flycatcher. The understory that develops provides new living places for birds like the hermit thrush and the winter wren. Construction of buildings removes vegetation; but the structures provide nesting locations for swallows, starlings, house finches, English sparrows, and (near water) black phoebes. The barn at Rancho del Oso is a home for at least 30 pairs of cliff swallows, house finches, a barn owl, and several black phoebes.

Park uses gradually destroy understory needed for food or nesting materials; campground noise and movement constantly disturb birds. This leads to our concern for the particularly sensitive marsh at the mouth of Waddell Creek, a small area in which hundreds of birds have been sighted. Constant intrusions would render it uninhabitable for many wintering waterfowl.



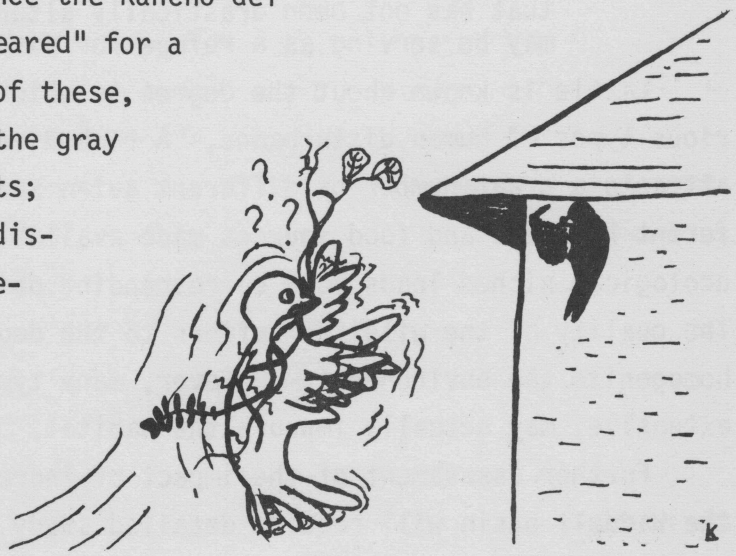
Fire has effects similar to those of logging. It clears out undergrowth and temporarily destroys habitat for species dependent on thick brush for protection or food. More important, trees killed or injured by fire become excellent nesting and food-storage sites for such species as woodpeckers, starlings, purple martins, and other insect-hawking birds. Fire prevention, on the other hand, at times

permits a dense accumulation of undergrowth, welcomed by wrentits, towhees, and some sparrow species (e.g., song sparrow, fox sparrow).

The diet of numerous bird species is changed directly and indirectly by the presence of people and their pets, particularly in the heavily used park areas. Scavenging species, such as the Steller's jay and acorn woodpecker, can be seen in great numbers around the headquarters and campgrounds of Big Basin Redwoods State Park. The increase in Steller jays undoubtedly has affected the populations of small birds in the area; the jay is known to rob other species' nests of eggs and nestlings for food (Orr, 1936). Increased use of park lands, combined with hunting and trapping pressures from surrounding areas, may have driven away one major predator, the mountain lion, and may have an effect on the reduced populations of bobcats, and other animals known to prey on birds.

Some evidence of changes in the species of birds to be found in the Big Basin drainage system can be found in the composite checklist of birds given in the Technical Appendix. The information under "last listed by" reveals that some species were listed only on the Rancho del Oso checklist (McLean, 1966), while others have been seen recently for the first time.

Birds not reported since the Rancho del Oso checklist have "disappeared" for a variety of reasons. Many of these, such as the wood ibis and the gray jay, are presumably vagrants; others may have gradually disappeared because of the presence of man. The roadrunner is no longer seen in Northern and Central California, presumably because much of its open-country habitat has been preempted by man. Other species, such as the yellow-



"But there was a TREE here last year!"

billed cuckoo and pileated woodpecker, have never been abundant. Many of these species no doubt still show up occasionally, but in such small numbers or so infrequently that they are not likely to be seen.

A few new land species, such as the starling, have been added to the basin in recent years. Several waterfowl and shore-bird species were noted in the marsh area in the winter and spring of 1972, the second year after the completion of the dam at the mouth of the marsh. Such species as the cinnamon teal, common goldeneye, bufflehead, ruddy duck, semi-palated plover, spotted sandpiper, and greater yellowlegs were listed for the first time in 1972, and future checks will help determine the frequency with which they visit the marsh. The cinnamon teal are breeding here; the other species were winter visitants and migrants. Several factors might explain this expansion of the checklist:

1. It is not known how frequently the marsh was observed in the past. Many of these "new" species were just making brief stopovers here.
2. The new dam may have altered the conditions of the marsh so that they are now more suitable for different birds. Besides preventing salt-water from entering the marsh at high tides, the dam has enlarged the dimensions of the marsh.
3. This marsh is one of the few local coastal freshwater bodies that has not been drastically altered or destroyed by man. It may be serving as a refuge for displaced birds.

Little is known about the degree to which birds can tolerate the various types of human disturbance. A rich diversity of plant communities attracts a great number of different avian species because of the many different habitats and food sources made available. Conversely, any loss of ecological niches leads to a corresponding decrease in the variety of birds. The quality of the wildlife suffers to the degree to which human activities homogenize the environment. However, many types of human actions, if not extensive, may actually improve the habitat.

Further assessment of the impact of increasing human activity within the Waddell basin will require detailed study of the habitat requirements of the many species involved. Like the prediction of impact on other wildlife species, it will also require quantifying the amount and type of development that would take place in a given area, coupled with a program of field observation.

REDUCED ANIMAL POPULATIONS

Man has directly caused the extinction of several animal species that once made the Waddell their home. In the last century, the California grizzly bear, the symbol of Western wilderness, was a feared and respected member of the basin community. This animal, however, presumably posed a great threat to the pioneers and their interests and was exterminated in the Santa Cruz Mountains by the late 1800s. In the early days of Villa Branciforte (near the present city of Santa Cruz), the Waddell valley was considered a good source of grizzlies for the bear-bull fights in the village (McLean, 1971).

The mountain lion is another extremely important predator whose habitat has been drastically reduced. The existence of the mountain lion in the Santa Cruz Mountains is further threatened by the new patterns of human land use. The San Francisco garter snake, which was once common in the San Francisco Bay Area, has become a rare and endangered species because its habitats have been suburbanized. It is likely that this animal still makes its home in the Waddell, along with some other animal species rare[1] to Central Coastal California. Some of these are listed below.

Species	Habitat	Status
Mountain kingsnake	near streams, moist, wooded areas	rare[1]
S.F. garter snake[2]	near streams, moist, wooded areas	rare & endangered
Shrew mole	moist, redwood forest floor	rare
Pileated woodpecker[3]	dense conifer forest	rare
Mountain lion[4]	throughout unpopulated areas	rare

1. "Rare" is applied here in the sense used by field biologists, as defined in McCaskie (1966). It implies that the animal is only very rarely seen, caught or detected by tracks or other signs when searched for in its preferred habitats.
2. Roger Luckenbach, Berkeley naturalist. Stebbins (1966) states that the known range of this animal extends as far south as Ano Nuevo Point. The San Francisco garter snake's status is officially noted in the IUCN Redbook.
3. Last sighted by Jim Christman, U.C.S.C. student, near the park headquarters at Big Basin in May, 1972 (see Technical Appendix).
4. Rudd (1948), p. 115-116.

CONFLICTING USES

Selected Ecological Management Problems

- Siltation and Succession in the Marsh
- Fire
- Exotic Plants
- Pastureland Succession
- Deer Management

Conflicts of Use Intensity

- Overview
- Salmon and Steelhead
- Armored Soils of the Chalks
- Sewage, Toilets, and Water Quality
- Outdoors Experience

Boundary Conflicts

- Overview
- Perimeter Problem
- Parcellization

Expansion of Big Basin Redwoods State Park will spread many of the human pressures associated with park use into areas that currently receive few visitors. Problems resulting from increased human activity in and adjoining newly acquired areas can perhaps be best discussed in three categories: ecological management conflicts, conflicts of use intensity, and park design and boundary conflicts. State Park staff members already must reckon with over a million visitors annually, and pressure for more facilities is increasing. At the same time, the staff is responsible for protecting their portion of the Waddell watershed from further degradation and for planning ahead to enhance the visitors' experiences.

SELECTED ECOLOGICAL MANAGEMENT PROBLEMS

SILTATION AND SUCCESSION IN THE MARSH

In the fall of 1970, the brackish marsh at the mouth of Waddell Creek was dammed by the Silver King Oceanic Farms for use as a fish hatchery. Before the dam was erected, material washed into the marsh was flushed out by the combined action of tides, normal stream flow, and an occasional major flood. They helped to maintain the marsh, deterring siltation and encroachment of plants. During the past two fairly dry years, visible deposits of silty material have been added where the creek empties into the marsh.

The marsh is one of the most absorbing and diverse natural features in the Waddell drainage. By its very character, it is a transitional landform and will eventually be filled. Yet, an estimate of the extent to which man accelerates this process is important knowledge to the park managers. It is also a fairly sophisticated problem for research, begging answers to numerous related questions. If U.C.S.C. continues to study the Waddell, monitoring changes in the marsh will be a high priority for research.

FIRE: TO BURN OR NOT TO BURN

Fire is commonly considered to be a menace to man and nature. A wildfire racing through an ancient forest, apparently leaving total destruction in its path, tends to reinforce this attitude. When an area is totally burned, countless organisms are destroyed and erosion is greatly accelerated. Moreover, aesthetic quality and recreational capacity are severely affected.

Nevertheless, fire has always been part of change in the natural world; and vegetation has become fire-adaptive, as in the chaparral and many forest communities. Fires passing through the great primeval forests usually did not destroy large trees but only small seedlings, herbs, and duff. Dangerous accumulations of burnable material were thereby cleared out.

Since man takes it upon himself to maintain the park's natural beauty, he must understand the methods by which this beauty is maintained. Fire should be strictly controlled in the park, but its usefulness as a land-

Fig. 34 Pastureland Succession
Coastal Scrubs invading an unused pasture points toward a conflict for park managers should grazing be discontinued.

Fig. 35 Exotic Plants
French broom, a European import, crowding a road in the upper valley. Must non-native plants be weeded from the parkscape?

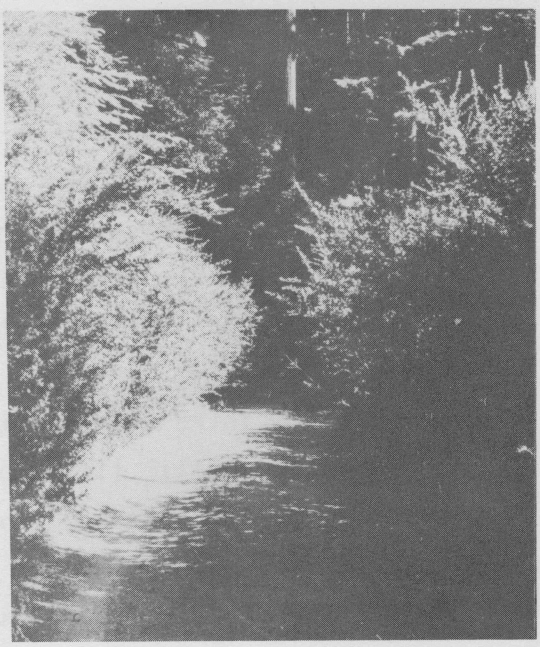
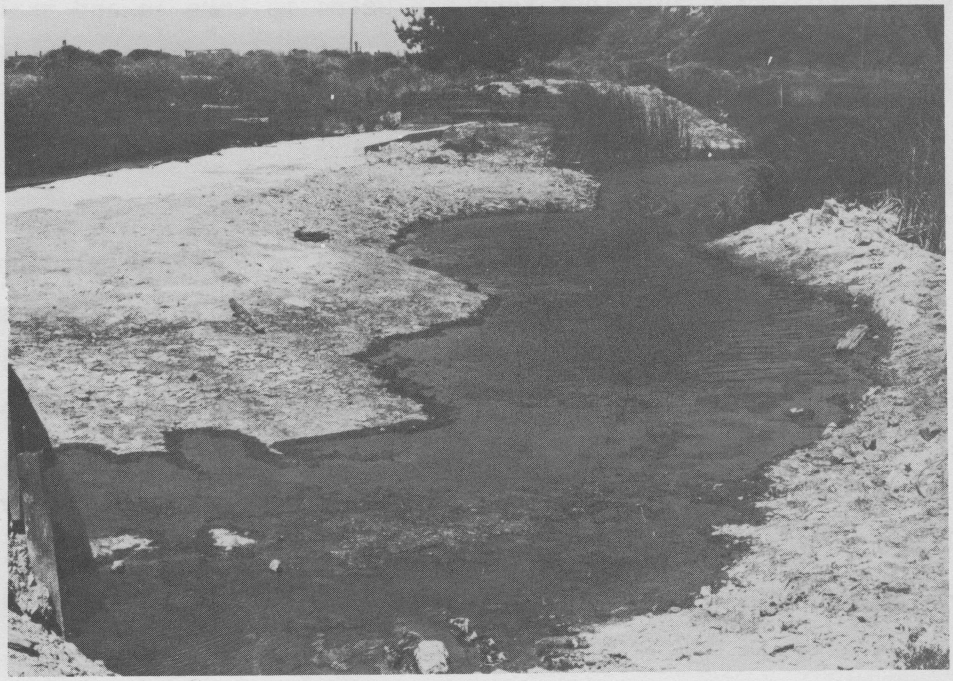


Fig. 36 Siltation of the Marsh
Will an innovative attempt at "fish farming" accelerate the natural processes slowly filling in the valuable marshlands?



management technique should not be overlooked. We would like to see the park managers explore the benefits and feasibility of a selective program of controlled burning, particularly in the Chalks and in the forest communities.

EXOTIC PLANTS

Since the time of the Spanish missionaries, seeds and slips of "exotic" plants from the Old World have been introduced into the Waddell and over most of the state. The spread of these non-natives over the California landscape is one of the major geographical transformations in the past few centuries. At places such as Asilomar Beach, the State Park's staff has investigated the feasibility of re-establishing the native communities as a way of offering a vignette of California before the arrival of the Spaniards.

Many introduced species may be found in the ranchlands upstream from the marsh: calla lilly, poison hemlock, foxglove, water cress, nightshade, vinca, mustard, French broom, ivy, and others, as well as pasturelands full of grasses such as Avena, Bromus, Erodium, Plantago, and Elymus. Several of these genera are now thoroughly established in the Waddell. An early decision is necessary on an attempt to replace these plants with California natives. The major concerns are that removal of these plants might simply leave open space for other European weeds to come in and that undesirable California natives, such as poison oak and coyote brush, might be the first to colonize these bare spots.

PASTURELAND SUCCESSION

When Portola and his company arrived in the valley in 1769, they probably saw a distinctly different valley floor, likely with more forested and brushy areas than today. Years later, settlers moved onto the land that is now Rancho del Oso and cleared much of the bottomlands to make room for pastures.

If grazing and pastureland maintenance were discontinued, native perennial plants and the overall height of the vegetative cover would likely increase. We anticipate that the pastureland might revert to a natural

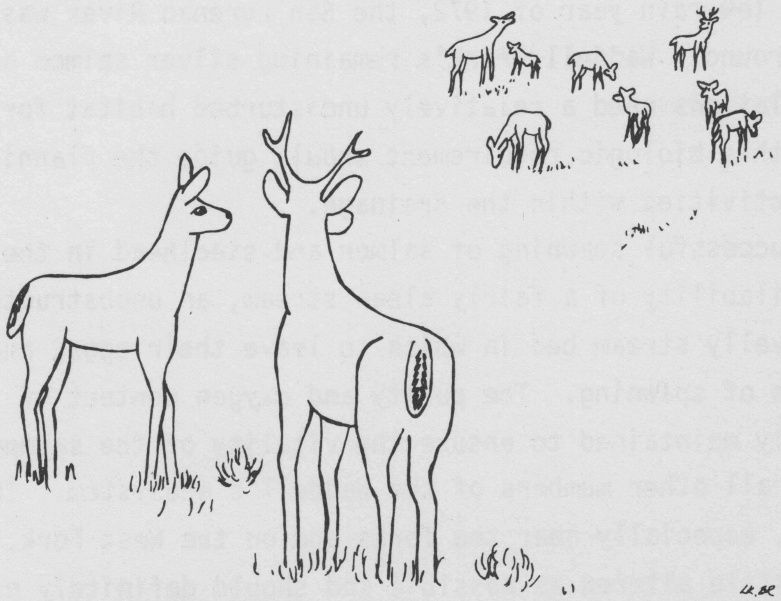
state, going through a series of many stages. Initially, coyote brush (Baccharis pilularis), poison oak (Rhus diversiloba), blackberry (Rubus vitifolius), and other scrubby natives would invade the field together with introduced species such as Scotch broom, hemlock ("wild carrot"),and thistle.

DEER MANAGEMENT: Antler to Antler in 1980

No common native animal locally inspires more interest than the mule deer. In state and national parks throughout the western United States, it is often fed at close range by well meaning visitors.

In Big Basin, a relatively large herd is relying, at least partially, on hand-outs. This unnatural diet may cause stomach disorders and also cause the animals to congregate in a small area, thus encouraging parasites and diseases. In a natural system, the chief predator of the mule deer--the mountain lion--would weed out the weak and sick individuals. A lion can kill approximately 50 deer per year; however, the mountain lion is no longer a very effective predator in the Waddell drainage.

Without natural deer control, the prolific herds could extensively damage the vegetation in an area and eventually starve. However, before any artificial management program is brought into full swing, systematic studies, such as one now underway by the Park System, are essential.



"I HEAR THAT THEY'RE THINKING OF PUTTING IN A HIGH-RISE MEADOW..."

CONFLICTS OF USE INTENSITY

OVERVIEW

The acquisition of private and corporate holdings within the Waddell basin by the State Park System would not, of course, halt man's impact, since intensive visitor use often alters the natural landscape. If the lower portions of the watershed are to be incorporated into the park, the park management should quickly decide on which areas to make accessible for recreational purposes and which to leave relatively undisturbed. An inventory of the recreational areas' potential sensitivity should provide clues as to what might be suitable uses of specific areas within the expanded park.

The State Park System may not be able to purchase all the lands within the watershed in the near or speculative future. As land values escalate and need for living space and open space grows, land-use controversies will increase.

SALMON AND STEELHEAD

Waddell Creek's importance as a spawning stream for silver salmon and steelhead has substantially appreciated as, one by one, local coastal streams have been polluted, dammed, or otherwise modified. For example, during the low-rain year of 1972, the San Lorenzo River was useless as a spawning ground. Waddell Creek's remaining silver salmon and steelhead trout populations need a relatively undisturbed habitat for spawning. Respect for this biologic requirement should guide the planning and designing of human activities within the drainage.

The successful spawning of salmon and steelhead in these waters depends on the availability of a fairly clean stream, an unobstructed stream channel, a flat gravelly stream bed in which to leave their eggs, and privacy during the periods of spawning. The purity and oxygen content of the stream should be carefully maintained to ensure the vitality of the salmon and steelhead as well as all other members of the Waddell's ecosystem. The areas along the stream, especially near the forks and on the West Fork, should continue to be as little altered as possible and should definitely not be dammed or

otherwise converted into swimming holes.

ARMORED SOILS OF THE CHALKS

The unique armored soils of the Chalks warrant special care and understanding management. The delicate ecosystem is based in a few inches of uncohesive, dusty soil, covered by the protective layer of small mudstone chunks. The armor is essential to plant growth on the parched ridges in several ways. It greatly reduces the rate of soil water loss, partly by shielding the earth from direct sun and partly because dew and fog condense on the undersides of the chalk fragments, providing the plants with a trace of moisture during the driest summer months. In the cooler, moister microenvironment of the shaded soil beneath the armor, humus forms more easily and seeds may more readily germinate in the damp, sheltered crannies between the armoring chunks. If this armoring is removed, the soil is soon washed or blown away, leaving a sterile slope of barren rock.

Even prior to the establishment of the park, the chalk soils slid periodically and were subject to occasional fires, treading, and other disturbance. The soils are able to tolerate a certain amount of localized disruption without serious damage to the ecosystem. What types of park uses the area can withstand without suffering major damage is a vital question. Construction, hiking, camping, and off-road cycling are all highly destructive to the protective armor. The extensive gullying spread around the existing roads and building sites in the Chalks can be studied to note the effects of various construction practices.

SEWAGE, TOILETS, AND WATER QUALITY

The disposal of human sewage is normally a complex, expensive, and often neglected aspect of land management. The expansion of park visitor facilities will necessarily include more toilets and sewage pipelines. This poses a problem for the State Park manager, who must adhere to public health standards and protect the quality of the stream waters and the environment in general. The establishment of toilet facilities is complicated by local conditions. For instance, increased sewage load might overtax the sewage plant at the expense of the aquatic ecosystem. This problem is com-

pounded by opposite seasonal patterns; during the visitor peak in summer, the stream is at low flow. Also, flush toilets require a lot of water. Forty per cent of the water used in the average household flushes the toilet (Grava, 1969); the percentage is probably even greater in a park. To prevent the damming of more streams, such as Sempervirens Creek, steps should be taken to eliminate unnecessary uses of this precious commodity. Any pumping of sewage from flush toilets on the beach or along the lower Waddell Creek upstream to the existing sewage treatment plant would be costly and could present technical problems.

The potential sewage problems of an expanded Big Basin State Park should be viewed in the context of other regional park disposal needs. Impending intensive use of the Ano Nuevo - Waddell Beach - Big Creek Lumber - Greyhound Rock corridor would suggest that a coordinated program for waste and sanitary disposal be undertaken. This point is underscored by a history of repeated failures of small-scale efforts by the state and county, notably at Greyhound Rock and Waddell Beach. Improper sanitation could degrade the fine sports diving areas in the kelp beds just offshore from the mouth of Waddell Creek. Sporadic suspension of diving permits due to pollution at Point Lobos State Reserve has already taxed the patience of local enthusiasts. It would appear highly advisable to investigate disposal alternatives prior to any decisions to locate park facilities in newly acquired areas.

THE OUTDOORS EXPERIENCE

People need to feel oriented, particularly outdoors. Physical clues, such as landmarks, communities, paths, smells, slopes, and noises, help in establishing a generalized mental image of the surrounding landscape. The impressions from the path traveled lend inner meaning to the image. The dependence on personal effort and perception for survival is a basic quality of moving through wildlands. Yet, the modern park visitor is seldom afforded such an experience. Both the tasks of survival and orientation have been diluted immensely. The Waddell visitor, equipped with roads, broad hiking trails, signposts, and pocket maps, now carries a visual umbilicus with mother culture and protects himself from part of what he seeks outdoors.

The traces of civilization scattered throughout the drainage basin dis-

tinctly modify and pattern the visitor's visual image. Roadcuts, stumps, litter, the saw mill, houses, lookout towers, and overhead jets amid the chalky ridges and somber redwoods are vivid reminders of a pervading culture. Many individuals enjoy the "humanness" of a landscape, whereas many others cherish the solitude and remoteness of a more "humanless" environment. Both preferences have a long history in the Waddell, and there is room for both in the future. The dilemma facing the park planners and managers is finding a balance that will maintain and enhance the values of the parklands and its environs.

One possible solution is to provide for a range of experiences. This is difficult, but the sensory landscape of the Waddell has a strong diversity, which could be encouraged in the expanded park. At present, impressions of man's activity emanate from a few scattered nodes, linked by strands of roads and trails. Wildlife, winds, and growing things reward their searchers with a more private alternative.

Undoubtedly, it will be less convenient to retain and encourage this wealth of opportunities. In trying to conserve the Waddell's diversity of values, the park managers will be faced with more conflicts in management than if they design for a uniform set of visitor tastes.

As compared with nearby watersheds along the north central coast, the Waddell has persevered well in maintaining its natural qualities. While the

Waddell is not generally recognized as a wilderness, it may be perceived as one in contrast to the nearby development. The grizzlies are now gone as are many of the giant redwoods. Still, the dynamic processes and overflowing currents of life are vividly apparent throughout the Waddell landscape. The visitor is offered a guided tour of the splendors of nature. To those who would perceive the watershed or parts of it as untouched wilderness, there lingers silent evidence of a maligned environment. An awareness of the domesticated quality of this landscape is not negative of defeating; it could prove to be a meaningful asset if integrally worked into the educational programs of the park, as well into policy planning and management perspectives.

BOUNDARY CONFLICTS

OVERVIEW

The fundamental conflict between public and private land ownership extends to the Waddell and could dwarf all other management conflicts.

The present park is in fragments - approximately 15 disconnected chunks and parcels. The state is actively trying to tie these into an integral whole by purchasing as much of the watershed as possible. This attempt is complicated by the large number of separate landholders, which is rapidly growing as areas such as the East Waddell and lower Last Chance Road are being subdivided. Citizen conservation groups, such as the Sempervirens Fund and Save the Redwoods League, can aid the park in systematically acquiring land. Nevertheless, there still remains the major conflict: private parcellization and park growth are spatially incompatible.

Increased use of an expanded park and adjacent properties could intensify present land use conflicts along the perimeter and possibly create new conflicts. The park itself will encourage a different and denser pattern of people on the land, impinging on the free use of adjacent private parcels. A serious attempt to minimize these conflicts should accompany any expansion of the park.

As the study progressed, we also gained a greater awareness of another fundamental conflict between property lines and the grain of the natural en-

vironment. The rigid rectangular ownership grid is not very sympathetic to the rugged landscape; mountaineering skills are required to cross a number of parcels in the East Waddell. This discordance tends to make any use of the land relatively difficult and wasteful, inviting abuse and poor management of the land. The pattern of property lines now expressed on the landscape leaves a promise of unnecessary problems for an expanding park and its neighbors.

THE PERIMETER PROBLEM: Conflicts between park and private uses along a revised boundary

The eventual expansion of Big Basin Redwood State Park could intensify land use problems along its perimeter and create new ones. Plans for an expanded park may conflict with the plans of neighboring private and corporate landholders. Three types of boundary problems are particularly threatening: (1) "gateway" commercialism; (2) subdivision for residential development; (3) exploitation of natural resources along park boundaries by neighboring industries.

Uncoordinated, parasitic commercial operations could undermine the gateway areas of the park. The Park System can not always accommodate all visitors' desires for services; as a result, private campgrounds, picnic areas, trailer parks, motels, or cabin rentals may spring up around the park. There is also a demand for convenience sales, such as fast-food stands and gas stations, both of which are extremely difficult to regulate effectively.

Traditionally, Santa Cruz County has allowed a great deal of such development, particularly in the nearby San Lorenzo Valley. Current land-use or zoning might permit or intensify gateway facilities at the Boulder Creek entrance to the park, any new park entrance near the coast and perhaps at Swanton Road or Whitehouse Creek. Advanced planning, involving all agencies concerned with these gateway areas, could alleviate many problems and even turn the need for services into a positive and integral part of a visit to Big Basin.

Residential development of land adjacent to the park or to its access routes could also raise conflicts. Major land development projects, many for second homes, are spreading throughout the state. A growing state park nearby could significantly boost land values and actually encourage this

type of land use. Housing developments scattered on the coastal terraces along Highway 1 are already anticipated by large corporate landowners. These corporations are likely to view the extension of Big Basin Redwood State Park toward their properties as a windfall.

The activities of nearby industrial operations could threaten the park proper as well. Logging and tree farming are carried out both in the surrounding watersheds and within the Waddell drainage. There is an uneasiness among neighbors, stemming from their differing demands on the land. Parks inconvenience loggers, and logging imposes on an adjoining park. We hope that these differences can be rationalized as best as possible within the constraints of the intrinsic conflict.

Transmission lines may encroach on the park as more homes are built on private lands in the watershed. If an electric power generating plant is built at Davenport (with nuclear or fossil fuels used), the transmission lines to the Monta Vista substation near Cupertino will be visible from some areas of the watershed. Although the lines themselves will not cross through the Waddell, impact on the important vistas from Pine Mountain and Eagle Rock may be considerable.

The Park System faces challenges far beyond its jurisdiction as a landlord - but as perhaps the most powerful force in the region, it should take responsibility for "upkeep of the neighborhood". In conjunction with nearby city and county agencies, it should develop firm policies regarding the aesthetic and environmental impact of park-related development. Implementing creative guidelines may prove to be as much of a challenge as the actual acquisition of new lands; private conservation organizations may be particularly helpful in this task.

PARCELLIZATION

Parcellization of land is occurring largely along the East Waddell Creek and Last Chance Road. Ironically, it is this area that contains some of the most beautiful features to be protected. The current development of this land for human habitation raises some serious questions regarding the future of East Waddell (map at the back of the report). Unfortunately, the zone of most active parcellization separates the existing park in Big Basin from the Rancho del Oso and serves, in effect, as a no-access strip, barring the easiest, continuous route along the creek from the Basin to the mouth. Many beautiful areas of East Waddell can be reached by private roads and paths and by traveling in the stream bed. Landowners, however, have the right to exclude hikers in order to preserve their personal privacy. The more persistent visitor may ignore such boundaries and thus bring the Park and private landholder into conflict.

Increasing human habitation of the land also diminishes the full enjoyment and appreciation of the area. An important asset of East Waddell is the solitude it affords, especially in the gorge. But this gorge is small and noises reverberate. It can accommodate only small numbers without overcrowding.

The dense rectangular grid of the property may indicate that speculators have taken a great interest in this area. Most of the land was originally purchased in large parcels. These parcels, in turn, are being repeatedly split and sold, with five acres being the minimum size. Santa Cruz County has not been able to effect any meaningful control over subdivision in this area. Once development starts, it tends to accelerate. One of the priorities for the State Park expansion should be the acquisition of large private holdings before extensive construction, habitation, and use despoil the natural qualities of the Waddell landscape. Uncontrolled lot-splitting, particularly along the East Fork, is a major and on-going threat to the integrity of the Waddell ecosystem.

There are three directions that land development could follow in this area:

1. The land could be acquired as part of Big Basin Redwood State Park
2. The present pattern of land use and resident structure could remain the same, however

3. The current trends suggest more extensive land speculation and development on the privately owned portions of the watershed.

Land development has a strong foothold in the East Waddell area. The total land in small parcels involves about 600 acres. Permanent structures have been built, garden plots have been cleared, and people are now securely settled in their homes. They chose the Waddell for its removed peace and the dream of simple freedom with the earth. But this dream brings the very real problems of human habitation into the rural landscape. Many homes are near the creek bed, for instance. Disposal of their sewage, handled through composting, is presently not a major problem. However, increased habitation, with increased sewage, could result in pollution of the creek, creating potential health problems. Further clearing, bulldozing, fencing, or construction would increase the danger of fire and imperial the beauty of this land.

Subdivision is an on-going and current process in the Waddell, which not only affects human impact but also tends to predetermine man's presence on the land. Therefore, we believed from the beginning of our study that a thorough knowledge of the existing landholdings and the patterns of change is vital to any geographic understanding of the environment. Some of the ownership data that we gathered and plotted are presented in the Technical Appendix.

CONCLUSION

Many individuals who have walked the entire Waddell understand its wholeness. It is a basic part of the land's beauty, part of the reason that long-time residents freely refer to "The Waddell". There are diverse elements in the area - a Big Basin, a Little Basin, gorges, and mesas - but they relate strongly when viewed from high points outside the present park boundaries.

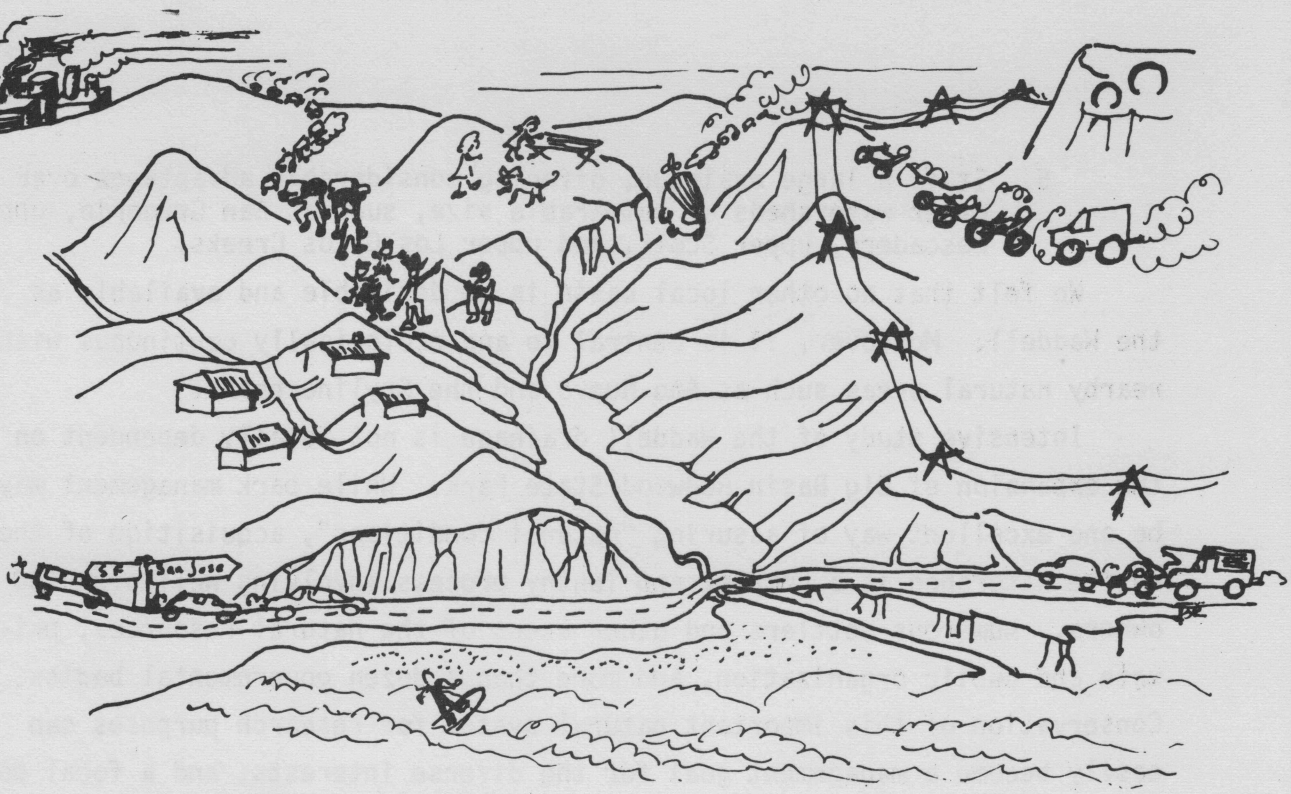
As the park expands toward the drainage boundaries, more visitors may share in this special perception. Surprisingly few people have had the chance to experience the basic unity of the basin, largely because it is now divided into private and public lands. The expanding park will open a way to wander to the ocean. If the entire drainage is suitably used for recreation and conservation, the park staff will have a natural unit in which the environmental integrity can be maintained. Basin-wide management could also help retain the superb integrating vistas and accessible silence of the seaward half of the Waddell.

Yet, while the coordinating concept of drainage basin is central to a

full understanding and enjoyment of the Waddell, there is another pressing reason for preserving the relatively undisturbed nature of the watershed.

The Waddell is needed as a model environment where the effects of rapid urbanization around the southern half of San Francisco Bay can be observed or monitored. Since World War II, the chains of small towns have emerged into a continuous urban area which is now expanding into the foothills and mountains. The new cities are being developed with traditions and techniques that evolved in other parts of the country, in areas having different environments. These practices are still quickly changing, responding to the particular conditions of Central California. Large, lightly used watersheds such as the Waddell are vital in evaluating the results of this grand experiment. Data that can be gathered from these watersheds can help shape land-use policies in the immediate future.

In the interim, an extensive built-upon landscape with distinct environmental patterns will continue to evolve, re-shaping some of the old familiar forms, such as the orchards of the Santa Clara Valley. Hydrologic and geologic processes are also being reordered in response to the new environment. Storm waters, for instance, are directed into different flow patterns in this suburban world. The impervious roofs, driveways, and streets, combined with smoother-than-natural gutters and concrete channels, speed more water into the streams and cause floods several times higher than before; dams are built in the foothills upstream, supplying large groundwater-recharge basins partly designed to compensate for the lower permeabilities in town. Animals must leave or adjust to new predators or changes in the plant communities. The rough-skinned newt, very apparent in the Waddell during winter and spring, is being excluded from the urban environment. This response is typical for many of the smaller native animals, and one which became especially meaningful to our group, since we consider the newt to be a strong and well-adapted member of the local biotic community. In a series of experiments, Stanford biologists determined that this newt will try returning to its home area for mating even if transplanted to another drainage miles away - although it may require the better part of a year or longer. Nonetheless, this hardy amphibian cannot cope with the solid belt of the built-up Peninsula, and now can easily be found only in the more open fringes of development.



Despite renewed interest in the environment, the totality of these changes in the local system is little understood. A few local residents, interested and observant, have become familiar with certain aspects of change over the years. Increasing numbers of people are watching and making comparisons. Occasionally, researchers are able to sustain and document a careful quantitative study, arousing interest in academic circles. Yet almost invariably these reports indicate the lack of knowledge - there is usually no data for comparison to check reliability or to see if the results are valid for more than just the tested area, nor is there the complementary information for analyzing the implications to other parts of the local ecosystem. All the observers seem to agree that a protected place to look and better understand is sorely needed.

This reconnaissance study concludes, then, that the Waddell drainage offers a unique opportunity for observation and research into the dynamic landscape of coastal Central California, since:

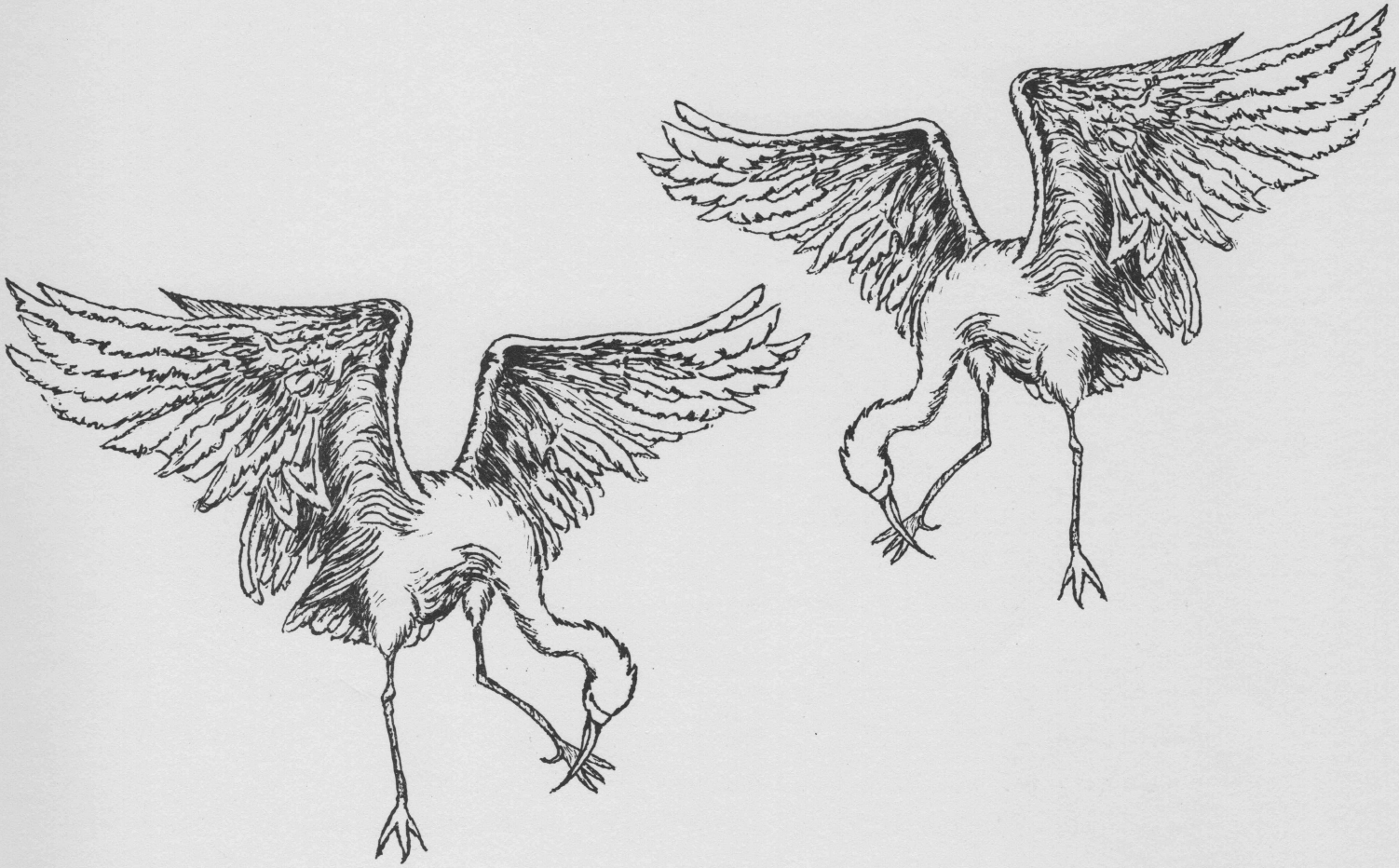
1. It is typical of drainage basins near the Bay Areas and adjacent portions of urbanizing coastlands.
2. It is in a fairly undisturbed condition as a result of careful management over much of the basin.
3. Approximately half of the basin is already managed by an expanding state park, and natural research is in accord with published planning policy for the area.
4. It includes a diverse biota, and a range of rock types and structures, allowing for freer research.

5. It is a large drainage, offering considerable advantages over other watersheds of comparable size, such as San Gregorio, upper Pescadero, upper Scott, and upper Los Gatos Creeks.

We felt that no other local basin is as desirable and available as the Waddell. Moreover, it is central to and ecologically continuous with nearby natural areas such as Ano Nuevo and the Skyline parks.

Intensive study of the Waddell drainage is not totally dependent on the expansion of Big Basin Redwood State Park. While park management may be one excellent way of assuring "natural conditions", acquisition of the entire watershed is a complex and lenthy process involving well over 100 owners, numerous settlers and other users of the natural resources, private and public organization, and more than a dozen governmental bodies. Conservation of this important natural system for research purposes can easily become a management goal for the diverse interests, and a focal point for future cooperation.

From all sides, there come increasing calls for selective preservation, partly because it enhances life in the Bay Area, and partly because we are increasingly aware of interacting with the local environment. We need places chosen for both recreation and observation, places large enough to feel the grain of the moving natural world around us. Recognizing our power to parcel and divide land down to man-sized pieces, we are attempting to re-unify part of it and gain access to a healthier whole. Together, these goals indicate a further maturing of the Bay Area community. They are expressions of the awareness that our culture intends a long stay in this part of the state. They reflect a need to direct our actions and activities in accord with an evolving long-term balance with natural processes. In the fullest sense, they represent an essential and meaningful aspect of growth in our community.



PART II
TECHNICAL APPENDIX

INTRODUCTION 1a

WATER: 2a - 9a
- Annual Rainfall Data
- Water Quality Tests: Results from the Waddell Watershed
- Stream Discharge Data

EARTH: 10a - 17a
- Geologic Units of the Waddell

LIFE: 18a - 49a
- The Major Plant Communities of the Waddell Drainage
- Birds of the Waddell Drainage
- Mammals Found in the Waddell Drainage
- Reptiles and Amphibians of the Waddell Drainage

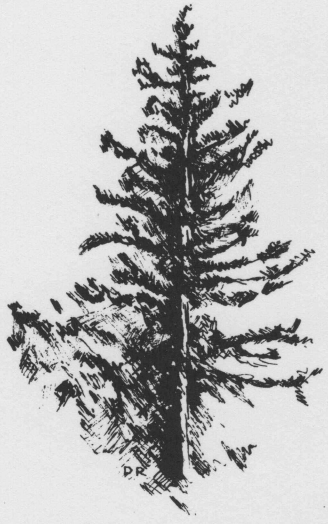
PROPERTY AND OWNERSHIP INFORMATION 50a - 51a

VISUAL IMAGE: 52a - 54a
- Observational Biases

VISITOR ATTENDANCE AT BIG BASIN 55a - 57a

TOPICS FOR FURTHER RESEARCH 58a - 60a

BIBLIOGRAPHY 61a - 65a



INTRODUCTION

The Technical Appendix includes much of the data that were used as reference or background material in our analysis of the Waddell environment. In addition to the information on the water, earth, life, visual image and use of the Waddell, we have included a section that describes some of the topics proposed for further study and a comprehensive bibliography of local information.

Future researchers can learn a good deal more about the Waddell from a number of other sources. These include skilled photographers, such as Howard King and Alexander Lowry, who have quietly and thoroughly documented the Waddell through their lenses. Members of the Big Basin staff, aided by the Sempervirens Fund, have amassed a wealth of information as they re-study the area's history. Local residents have gained a deep and critical understanding of the Waddell and its surroundings; in some instances (such as McLean, 1971), their accounts are published and are readily available.

Stream gauging records are an important source of environmental information. Waddell Creek itself has only been gauged sporadically. However, useful data from Scott Creek and other nearby drainages can be found in the two reports listed in the bibliography under U.S. Geological Survey, 1970.

Finally, we hope that this report represents only an initial reconnaissance of the Waddell. Members of our department hope to begin long-range, detailed observations of the drainage as conditions continue to change.

ANNUAL RAINFALL DATA

HEIGHT	2200 feet	2640 feet	273 feet	450 feet
LOCATION	Boulder Creek Locatelli Ranch	Crest Ranch	Davenport	Boulder Creek Shell Station
YEAR				
1940				98.02
1941				73.93
1942	71.62			55.74
1943	52.53			41.34
1944	61.99			52.81
1945	60.61			40.26
1946	33.75			34.60
1947	40.33			39.75
1948	50.22			44.92
1949	46.99	42.31		44.58
1950		103.08		67.93
1951		77.35		87.52
1952	79.48	94.55		56.85
1953	44.63	61.97		45.82
1954	66.73	93.10		47.29
1955	66.57	98.00		72.70
1956	40.94	41.45		42.05
1957	64.32	66.04		
1958		66.93		40.99
1959	49.35	45.91		40.54
1960	52.84	53.57		31.09
1961	34.97	37.90	16.19	52.31
1962	72.92	75.10	25.35	76.41
1963	72.27	62.63	29.99	37.24
1964	63.02	62.17	25.18	68.72
1965		54.74	23.49	40.00
1966				82.43
1967				40.77
1968				80.70
1969				56.60
1970				55.41
MEAN RAINFALL	56.3"	61.0"		55.9"

Sources:

Locatelli Ranch, Davenport — from USWB records
Crest Ranch — from Howard A. Nielson, 12500 Empire Grade
Boulder Creek — from San Lorenzo Valley Water District records

WATER QUALITY TESTS:
RESULTS FROM THE WADDELL WATERSHED

This study was planned as a reconnaissance sampling program of water quality in the Waddell. Ideally, repeated tests should have been made throughout the drainage at the same times and locations. This was not feasible; however, the results of this study should prove to be indicative of present conditions.
The locations of water quality testing stations are given beginning on page 5a, followed by the explanatory notes.

#	DATE (1972)	TIME	FECAL[2] COLI	TOTAL[3] COLI	FECAL[4] STREP	DO[5] ppm	ORTHO[5] PO_4 ppm	NO_3[5] NO_2 ppm	pH[6]	DAYS SINCE[7] STORM
1	4-29		26		4				7.5	6
2	4-29		100		4				7.6	6
3	4-29		80		2				7.55	6
4	4-29		90		170				7.35	6
5	4-29				2				7.35	6
6	4-29		8		0				7.1	6
7	4-29		214#		8				7.1	6
8	2-21	9:00	38	70					7.0	15
9	2-12	10:00	225#	270	43mpn	14	0.5	0.5	7.1	6
10	1-29	10:00	160	250					7.5	7
10	2-12	11:00	124	210		14	1.5	0.5	7.4	6
10	2-21	10:00	74	96					7.5	15
10	2-28	9:00	125	200					7.55	22
10	4-29		112		68				7.4	6
10	4-15								7.5	3
11	4-23	9:30	0				1.2	3	7.65	0
12	4-23	9:30	0				0.25	3	7.6	0
13	4-23	9:30	4					2	7.8	0
14	4-23	9:30	6						7.8	0
15	4-23	9:45	3						7.85	0
16	4-23	10:30	20						7.7	0
17	4-23	10:30	60						7.7	0
18	4-23	10:45	75						7.73	
18	4-15								7.75	
17		17:00				13	0.5	0.5		
18	2-12	11:00	100	130		14	1.5	0.5	7.6	6
18	4-29		106		50				7.55	6
18	2-21	10:00	100	122		13	0.5	0.5	7.75	15
18	2-28	9:00	160	200					7.8	22
19	4-15								7.8	3
20	4-15								7.7	3
20	2-21	11:00	110	160		13	0.2	0.5	7.7	15
20	2-28	9:00	95	130					7.8	22
21	2-12	12:00				13	3	11	6.8	6
21	1-29	11:00							6.9	7
21	2-21	11:00				13	10	53		15

#	DATE (1972)	TIME	FECAL[2] COLI	TOTAL[3] COLI	FECAL[4] STREP	DO[5] ppm	ORTHO[5] PO_4 ppm	NO_3[5] NO_2 ppm	pH[6]	DAYS[7] SINCE STORM
21	2-28	9:00					10	62	6.95	22
21	4-29		0?		0?		9.3	17.4	7.15	6
21	4-15						8+	7.5	7.3	3
22	2-21	11:00	62	110			2	11	7.7	15
22	2-28	9:00	0	0				0.66	7.75	22
23	2-21	13:00	4	170					7.8	15
23	4-15						1.2	1	7.7	3
24	4-15								7.75	3
24	2-21	12:00	86	120			1.5	0.66	7.7	15
24	4-29		2?		0?		6.3	1.08	7.4	6
25									7.75	3
26	2-12	13:00	42	70		15	0.5	0.5	7.6	6
30	1-22	14:00				16	0.5	0.5		?
30	2-12	14:00	24	58	3.6mpn	13	0.5	0.5	7.7	6
31	2-12	15:00	30	39					7.7	6
31	2-21	14:00	6	21					7.9	15
32	2-12	15:00	5	220		1	5	0.5	6.2	6
33	2-21	16:00	21	120					7.9	15
34	3-4		16		2				8.0	27
34	3-4		22		2				7.95	27
35	2-12	16:00	0	14	3.6mpn				7.2	6
35	3-4		0		0				7.3	27
36	2-12	17:00	20	74		13	0.5	0.5	7.7	6
37	3-4		22		2				8.0	27
38	1-23	16:00							8.0	1
39	1-23	13:00	44	50					8.05	1
40	3-4		16		2				7.95	27
41	1-23	13:00	1			12	3	0.5	8.1	1
42	1-23	12:00	50			13	2	0.5	7.15	1
43	1-29	16:00	60						7.7	7
44	3-5		80						8.1	28
44	3-11		36						8.1	34
45	3-11		14						8.0	34
46	3-5		22						7.8	28
46	3-11		0				0.5	0.5	7.75	34
47	3-5		14						7.85	28
47	3-11		80						7.9	34
48	3-11		50						7.95	34
49	2-28	14:00	2						7.85	22
50	2-28	14:00	10	34					7.9	22
51	2-28	12:00	0	22					8.3	22
52	2-28	12:00	2	8					8.1	22
53	1-22	12:00				13	0.5	0.5		?
53	2-28	13:00	22						8.0	22
54	3-11		12				0.5		7.5	34
55	3-11		0				0.5	0.5	6.8	34
56	3-11		10				4	0.5	7.25	34

#	DATE (1972)	TIME	FECAL COLI[2]	TOTAL COLI[3]	FECAL STREP[4]	DO[5] ppm	ORTHO[5] PO_4 ppm	NO_3 NO_2[5] ppm	pH[6]	DAYS SINCE STORM[7]
57	1-22	12:00				13	0.5	.8?		?
57	2-28	13:00							7.8	22
58	2-19	14:00	12				0.5		7.7	13
59	2-19	14:00	7				0.5	0.1	7.9	13
60	2-19	14:00	15				0.5	0.1	8.0	13
61	2-19	14:00	0				1	0.1	7.25	13
62	2-19	13:00	1				2	0.1	5.9	13
63	2-19	15:00	7						7.4	13
64	2-19	16:00							7.7	13
65	3-9				14				7.7	32
66	3-9				22	10	1	0.1	7.5	32
67	3-9				14	10	3.5	0.1	7.5	32
68	2-29	16:00		85					7.5	23

NOTES ON WATER QUALITY SAMPLING

1. All tests for bacterial contamination were carried out within 12 hours of sample collection. All coliform and most streptococci tests were made using the millipore filter technique. A few streptococci samples (mpn) were determined by the fermentation tube method. Results are reported as the most probably number (mpn) of colonies per 100 ml. of sample water.

2. FECAL COLIFORMS
   The Santa Cruz County Health Department considers 100 ml. of water containing more than 200 fecal coliforms to be unfit for swimming. Four fecal coliforms are acceptable in drinking water.

3. TOTAL COLIFORMS
   The U.S. Health Department considers that if a sample of 100 ml. of water contains more than 1000 total coliforms it is unfit for swimming. Four fecal coliforms are acceptable in drinking water.

4. FECAL STREPTOCOCCI
   We were not able to find any standards for fecal streptococci; however, since fecal streptococci die faster in fresh water than coliforms, they may indicate either more recent pollution or proximity to a pollution source.

5. CHEMICAL PROPERTIES
   Tests for dissolved oxygen, phosphates, and nitrates were carried out in the field using HACH kits. We estimate the accuracy of these results to be within 20% of the actual concentrations.

6. pH
Tests for pH were carried out in the lab on a Beckman pH meter within 12 hours of the sample's collection.

7. Storms are rainfall events exceeding 0.5 inches of precipitation. (Harris, E.E., and S. Rantz, 1964, "Effect of urban growth on streamflow regimen of Permanente Creek," Santa Clara County, California; U.S. Geol. Survey Water Supply Paper 1591-B, 18 p.)

#: This water sample is above the standards for water contact sports set by the Santa Cruz County Health Department (200 f.c./100 ml.).

mpn: These were sampled according to the fermentation tube method. See note 1.

WATER QUALITY STATIONS, 1972

1 Bloom Creek above Little Basin Creek
2 Mouth of Little Basin Creek
3 Little Basin Creek
4 Bloom between Little Basin Creek and Park above sand filter
5 Bloom between Little Basin Creek and Park below sand filter
6 Bloom at old mill site at park boundary
7 Tributary of Bloom in Park
8 Bloom Creek under trail bridge
9 Bloom Creek at upper end of campgrounds below confluence with Sempervirens Creek
10 Bloom Creek above confluence with Opal Creek
11 Clear Creek above shale
12 Clear Creek on shale
13 Opal Creek above shale
14 Opal Creek on shale
15 Opal-Clear Creeks (below shale)
16 Opal Creek above campgrounds
17 Opal Creek between campgrounds and Park headquarters
18 Opal Creek above confluence with Bloom Creek
19 East Waddell below confluence of Bloom Creek
20 East Waddell 50 feet above sewage discharge
21 Big Basin sewage outlet
22 East Waddell 50 feet below sewage discharge
23 Sewage Plant creek (runs thru culvert under plant)
24 East Waddell 200 feet below sewage discharge
25 East Waddell 50 feet above sewage discharge
26 East Waddell at second turnout below sewage plant
27 East Waddell where Last Chance Creek crosses it

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57	2-28	13:00							7.8	22
58	2-19	14:00	12				0.5		7.7	13
59	2-19	14:00	7				0.5	0.1	7.9	13
60	2-19	14:00	15				0.5	0.1	8.0	13
61	2-19	14:00	0				1	0.1	7.25	13
62	2-19	13:00	1				2	0.1	5.9	13
63	2-19	15:00	7						7.4	13
64	2-19	16:00							7.7	13
65	3-9				14				7.7	32
66	3-9				22	10	1	0.1	7.5	32
67	3-9				14	10	3.5	0.1	7.5	32
68	2-29	16:00		85					7.5	23

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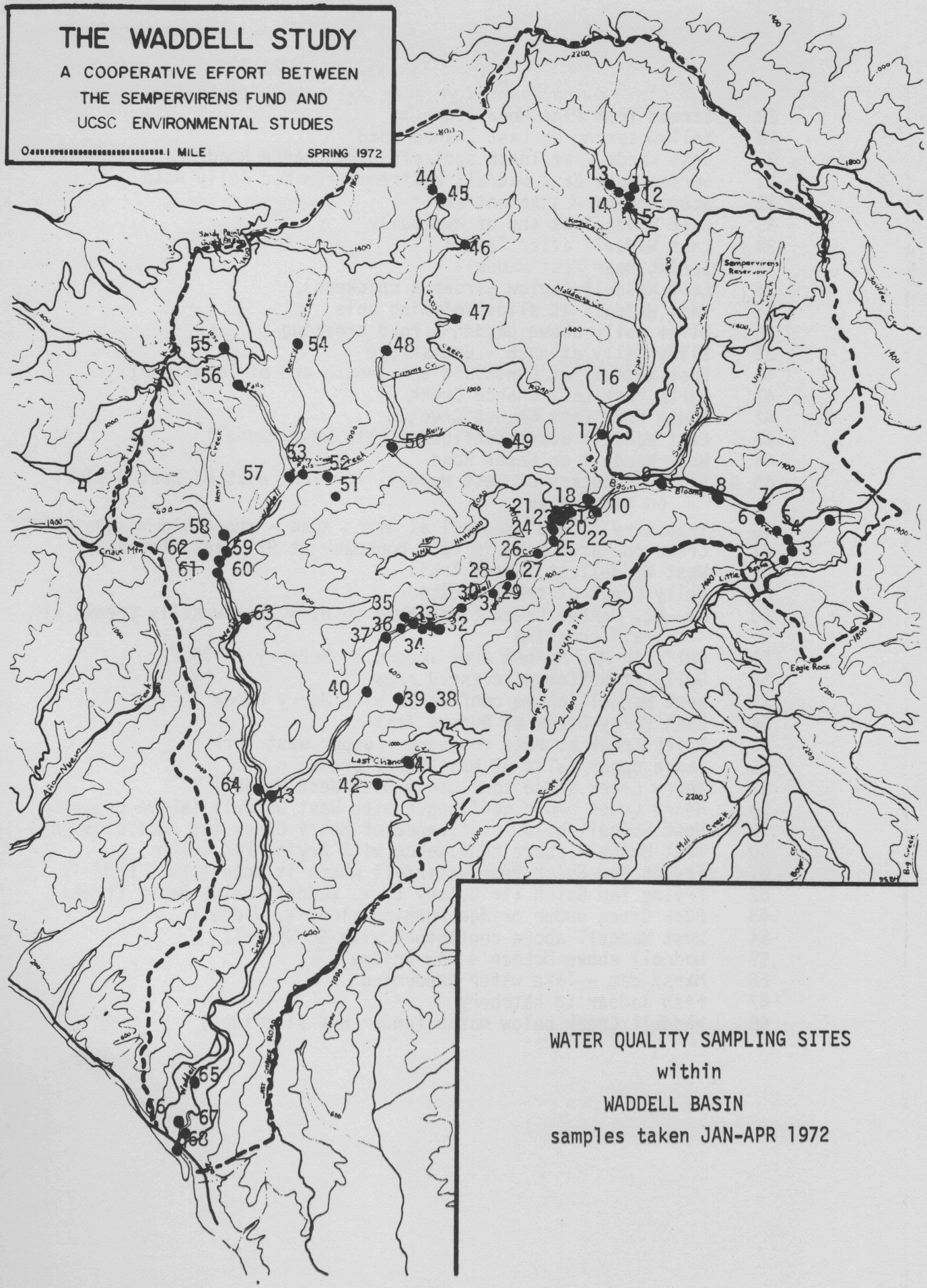
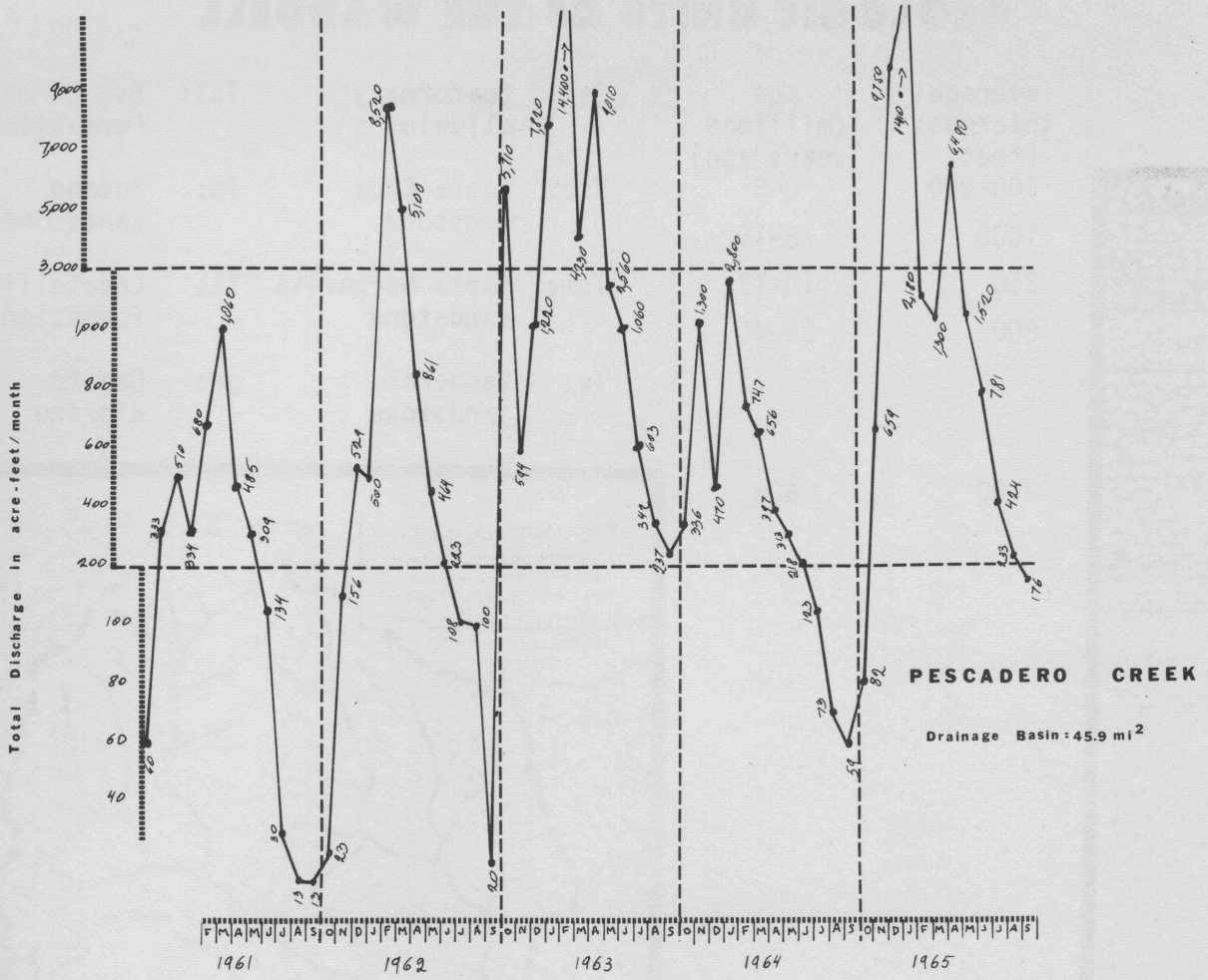
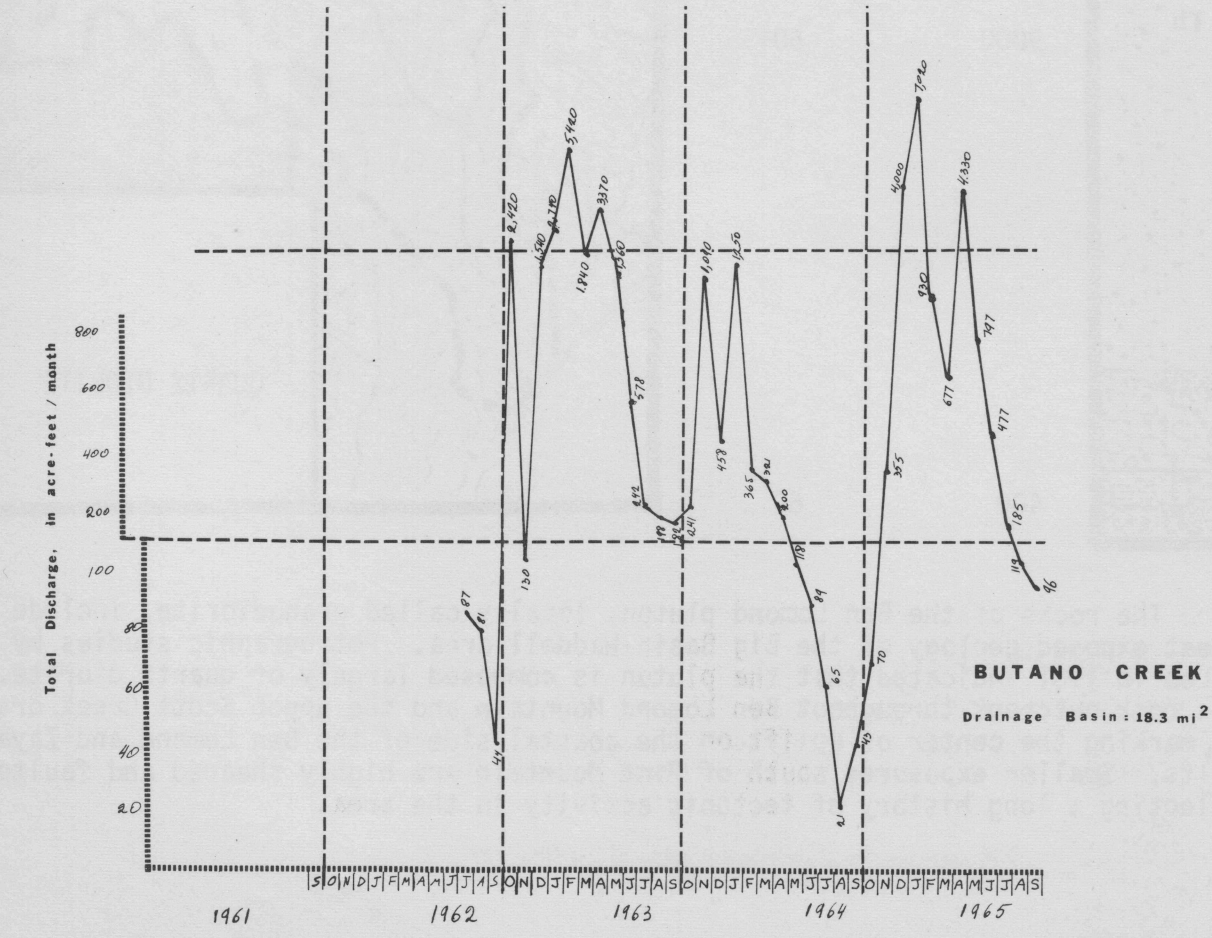

THE WADDELL STUDY
A COOPERATIVE EFFORT BETWEEN
THE SEMPERVIRENS FUND AND
UCSC ENVIRONMENTAL STUDIES
0 1 MILE
SPRING 1972
WATER QUALITY SAMPLING SITES
within
WADDELL BASIN
samples taken JAN-APR 1972

28 Stream from Pine Mountain
29 Yellow spring on Last Chance Road
30 East Waddell at lunch spot off Last Chance Road
31 Spring near East Waddell upstream from Mud Gully Road
32 Scum Spring - stagnant water
33 East Waddell at end of Mud Gully
34 East Waddell after island
35 Spring near East Waddell
36 East Waddell (below garden & chickens)
37 East Waddell at slide swimming hole
38 Slide gully above garden & road crossing
39 Slide gully at path - downstream
40 East Waddell at Cynthia's spa (south end of landslide)
41 North Fork Last Chance Creek
42 South Fork Last Chance Creek
43 East Waddell above confluence with West Waddell
44 West Waddell on Gazos Road
45 Small tributary of West Waddell 100 feet east of West Waddell on Gazos Road
46 Tributary to West Waddell at Gazos Road - above old wooden bridge
47 Creek on Gazos Road in Park boundary at 915 feet elevation
48 West Waddell at Sunset Trail
49 Kelly Creek at trail crossing
50 No. Mt. McAbee Creek (tributary to W. W. below Kelly Creek) at trail crossing
51 Gully in Mt. McAbee area logged by McCrary in 1962
52 Gully at bottom of cleared area
53 West Waddell above confluence with Berry Creek
54 East Berry Creek at Sunset Trail
55 Berry Creek at road crossing - upper west fork
56 Above upper falls of West Berry Creek
57 Berry Creek above confluence with West Waddell
58 Henry Creek above confluence with West Waddell (above crossing)
59 West Waddell below confluence of Henry Creek (at road crossing)
60 West Waddell above confluence with Frying Pan Gulch
61 Frying Pan Gulch from waterfall where it enters West Waddell
62 Frying Pan Gulch (tributary to W. Waddell below Berry Creek)
63 Buck Creek under bridge running along W. Waddell
64 West Waddell above confluence with E. Waddell
65 Waddell above McLean's new bridge
66 Marsh dam - lake water impounded
67 Fish ladder to hatchery
68 Waddell Creek below marsh (under Hwy #1 bridge)


Total Discharge in acre-feet/month
9,000
7,000
5,000
3,000
1,000
800
600
400
200
100
80
60
40
F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S
1961
1962
1963
1964
1965
PESCADERO CREEK
Drainage Basin: 45.9 mi²


Total Discharge, in acre-feet / month
800
600
400
200
100
80
60
40
20
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S
1961
1962
1963
1964
1965
BUTANO CREEK
Drainage Basin: 18.3 mi²

GEOLOGIC UNITS OF THE WADDELL

	average thickness (feet)	age (millions years ago)
Qal	100-200	0-3
Tsc	1000	8-10
Tsm	250	10-12
Tv	800	25-40
Tsl	2500	40+
Tb	9000	50+
Tl	400	60
gr		

Qal: Quaternary alluvium

Tsc: Santa Cruz mudstone

Tsm: Santa Margarita sandstone

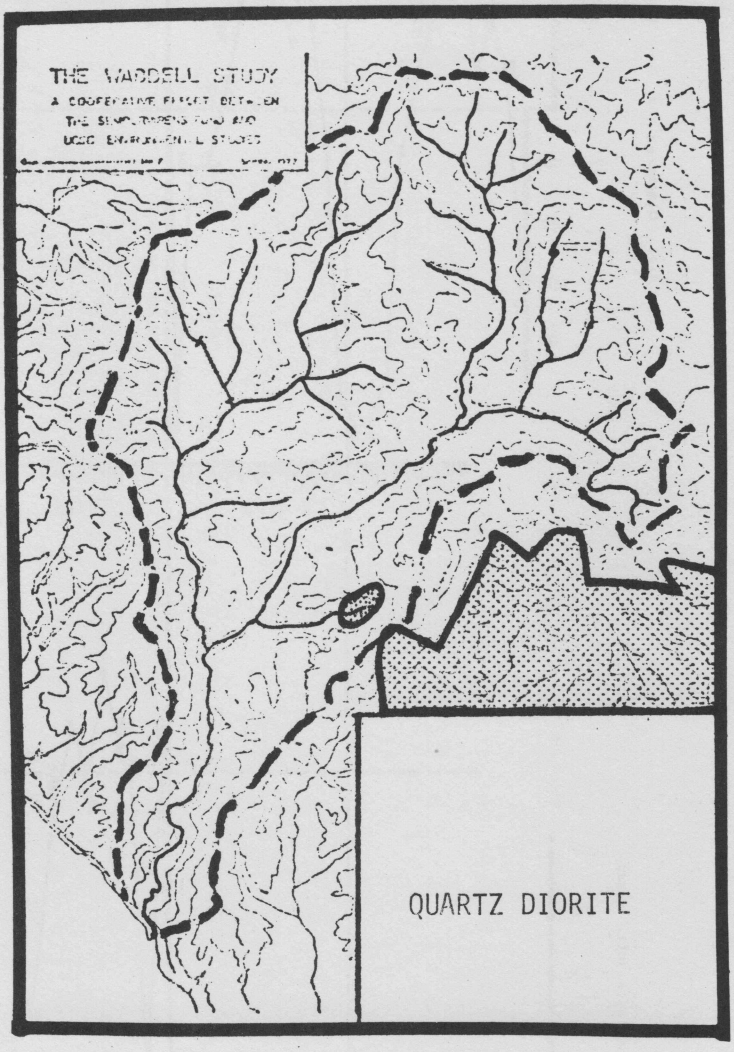
Tv: Vaqueros sandstone

Tsl: San Lorenzo Formation

Tb: Butano sandstone

Tl: Locatelli formation

gr: Quartz diorite



The rocks of the Ben Lomond pluton, locally called granodiorite, include the oldest exposed geology of the Big Basin-Waddell area. Petrographic studies by G. W. Leo in 1961 indicated that the pluton is composed largely of quartz diorite. This rock outcrops throughout Ben Lomond Mountain and the upper Scott Creek drainage, marking the center of uplift on the coastal side of the Ben Lomond and Zayante Faults. Smaller exposures south of Pine Mountain are highly sheared and faulted, reflecting a long history of tectonic activity in the area.

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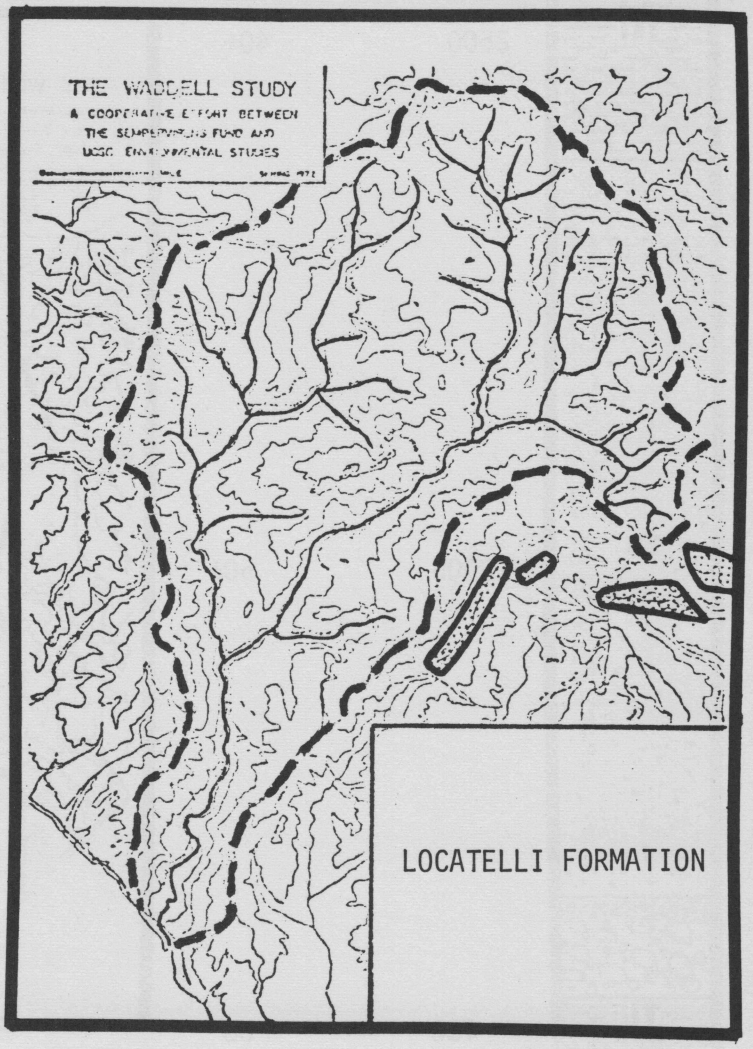
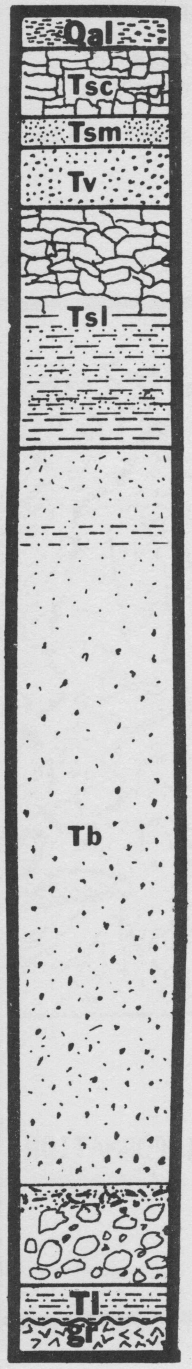
gr: Granodiorite



The Locatelli is the oldest sediment found in the Waddell-Big Basin area, resting unconformably on the quartz diorite "basement" rock. It consists of finely laminated sands and mudstones within a massive siltstone. Microfossil studies (Brabb,1960) indicate that the Locatelli was deposited in the Ynezian stage, 60 million years ago. Exposures are found near Locatelli Ranch, Jamison Creek, and Scott Creek.



	average thickness (feet)	age (millions years ago)
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Tsc	1000	8-10
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Tl	400	60
gr		

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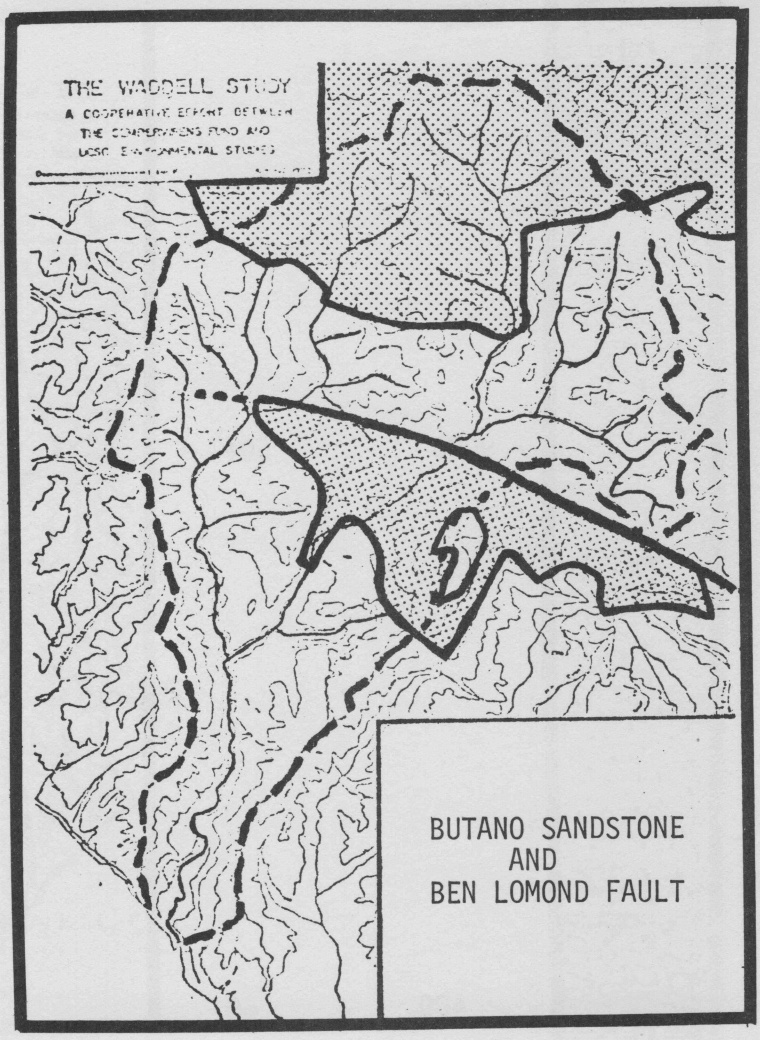

The Butano is a massive sandstone, at least 9000 feet thick. Although mostly a well indurated medium to coarse sandstone typified by the cliffs of the East Waddell gorge, the unit varies from finely-laminated sand and silt along Gazos Creek Road to a massive boulder conglomerate along Jamison Creek. "Local" pebbles within the conglomerate, interbeds containing large amounts of woodchips from huge fires, evidence of turbidity currents (Touring, 1959), and microfossil studies (Brabb, 1960), all indicate that the Butano was deposited in moderately deep water with sediments derived from local, nearshore turbidity currents.

	average thickness (feet)	age (millions years ago)
Qal	100-200	0-3
Tsc	1000	8-10
Tsm	250	10-12
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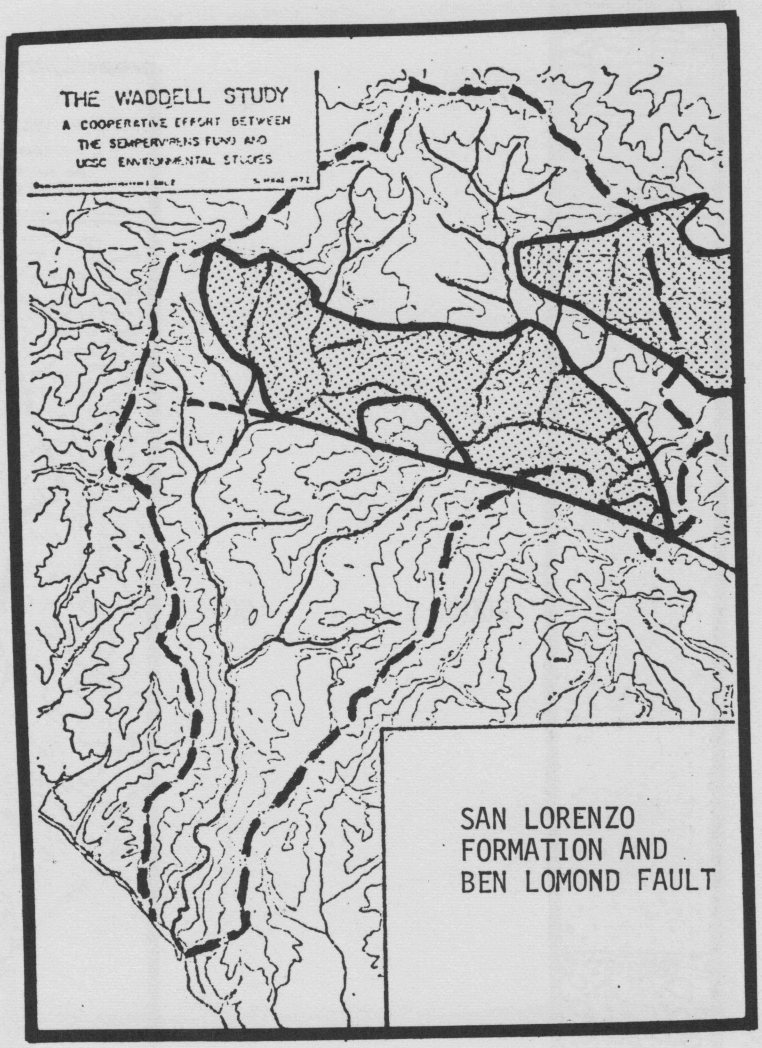
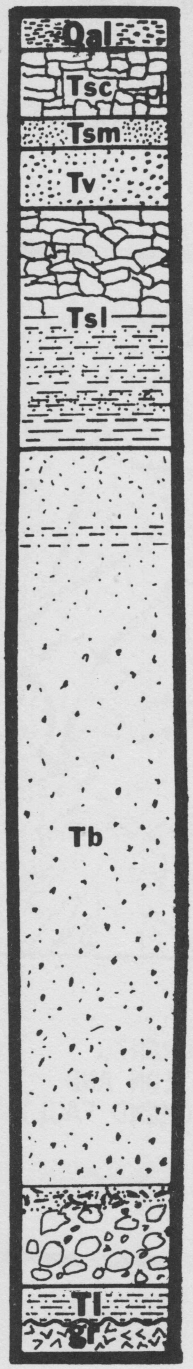


The San Lorenzo Formation consists of two members: the Rices mudstone and the older Two Bar shale. The Two Bar is frequently interbedded with fine to coarse-grained friable quartzose sandstone and is susceptible to sliding. The San Lorenzo is abundant throughout Big Basin and the West Waddell area, but is not exposed southwest of the Ben Lomond Fault. Uplift along the Fault resulted in the erosion of the entire formation between Big Basin and the coast.



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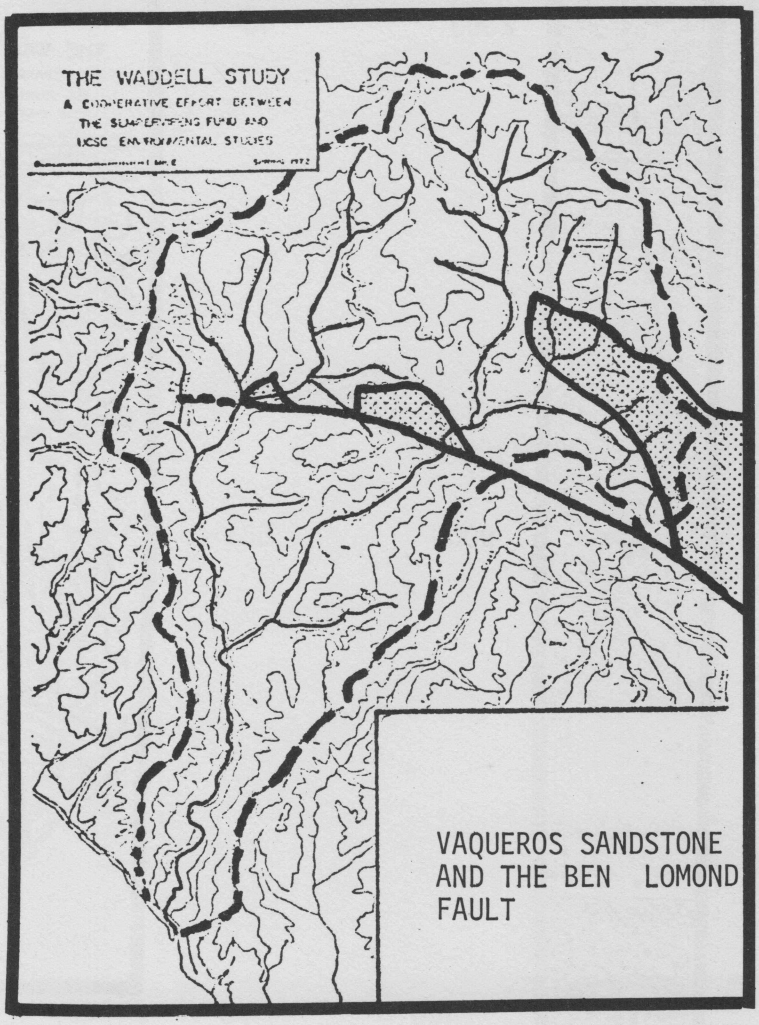
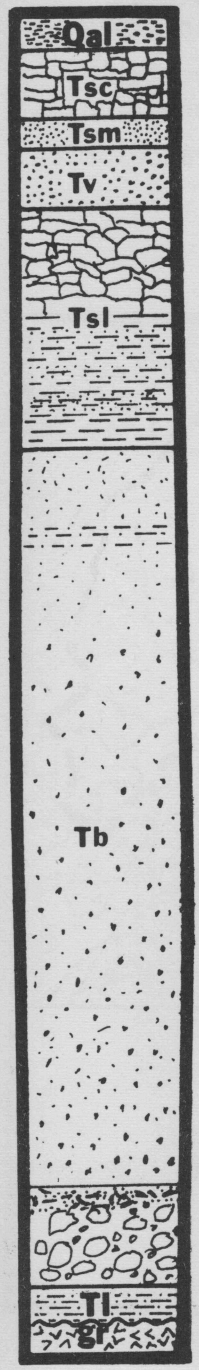


The Vaqueros is of Oligocene age, ranging in thickness from 500 to 800 feet. The sandstone is an arkosic arenite, with a typical composition of 55% quartz, 27% Kspar, 10% plagioclase, and 4% clay (Brabb, 1960). The Vaqueros sandstone, also not exposed southwest of Ben Lomond Fault, is distinguished from Santa Margarita by coarser and more angular grains and a generally "dirtier" (higher clay content) composition. Also noted from field work in the area was that isolated knobs and saddles are much more abundant in Vaqueros than any other sandstone in the Waddell basin.



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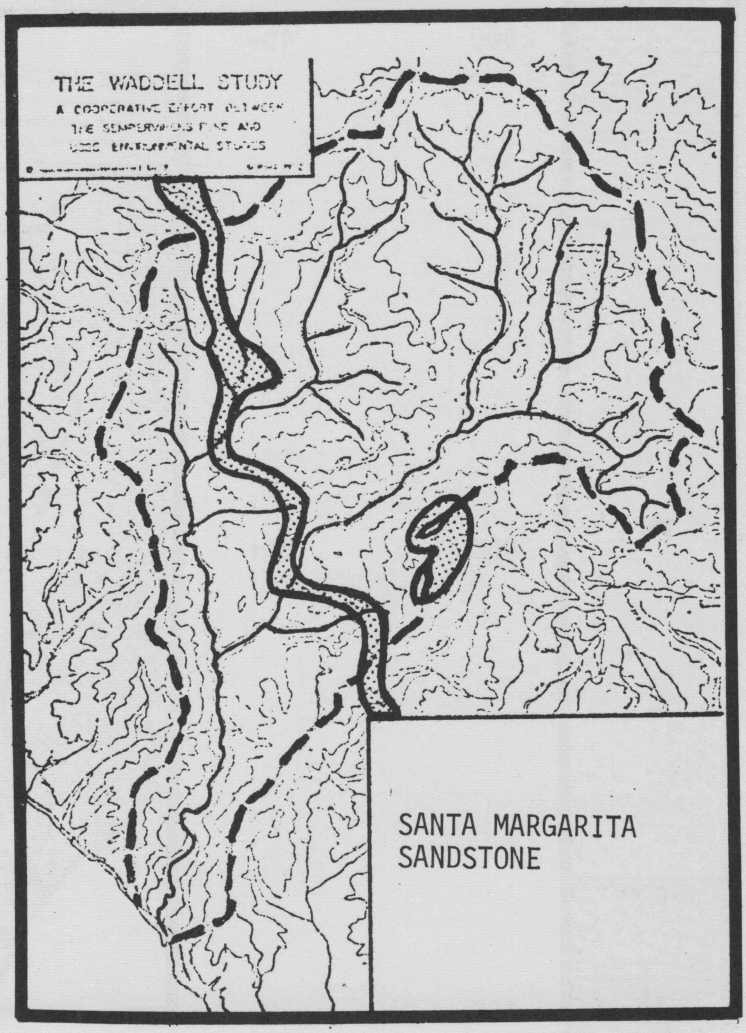
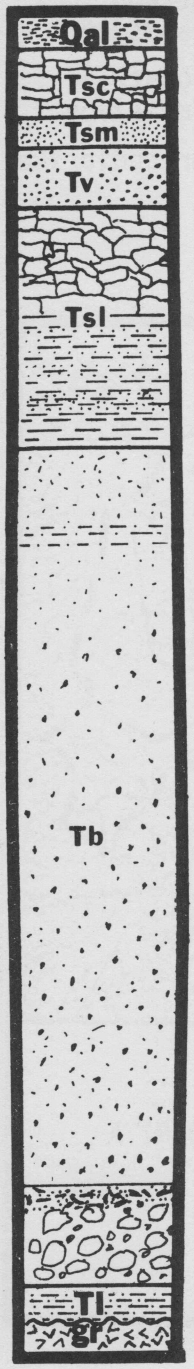


In the Waddell area, the Santa Margarita sandstone is composed primarily of medium to fine-grained quartz sand, with small pebbles commonly interspersed in small beds and lenses. It usually shows a characteristic white-to-light grey coloring, partly due to the high percentage of quartz sand and low amounts of clay. The beds dip seaward at angles of 6-25 degrees, helping to distinguish it from the more tilted Butano sandstone south of the Ben Lomond Fault. The Santa Margarita is typically 100-250 feet thick in the drainage, but locally thins to 30 feet or less. Structures within the sandstone suggest that it was deposited in a near-shore environment with the sediment locally being derived from the east, possibly from an ancestral Ben Lomond Mountain.



	average thickness (feet)	age (millions years ago)
Qal	100-200	0-3
Tsc	1000	8-10
Tsm	250	10-12
Tv	800	25-40
Tsl	2500	40+
Tb	9000	50+
Tl	400	60
gr		

Qal: Quaternary alluvium

Tsc: Santa Cruz mudstone

Tsm: Santa Margarita sandstone

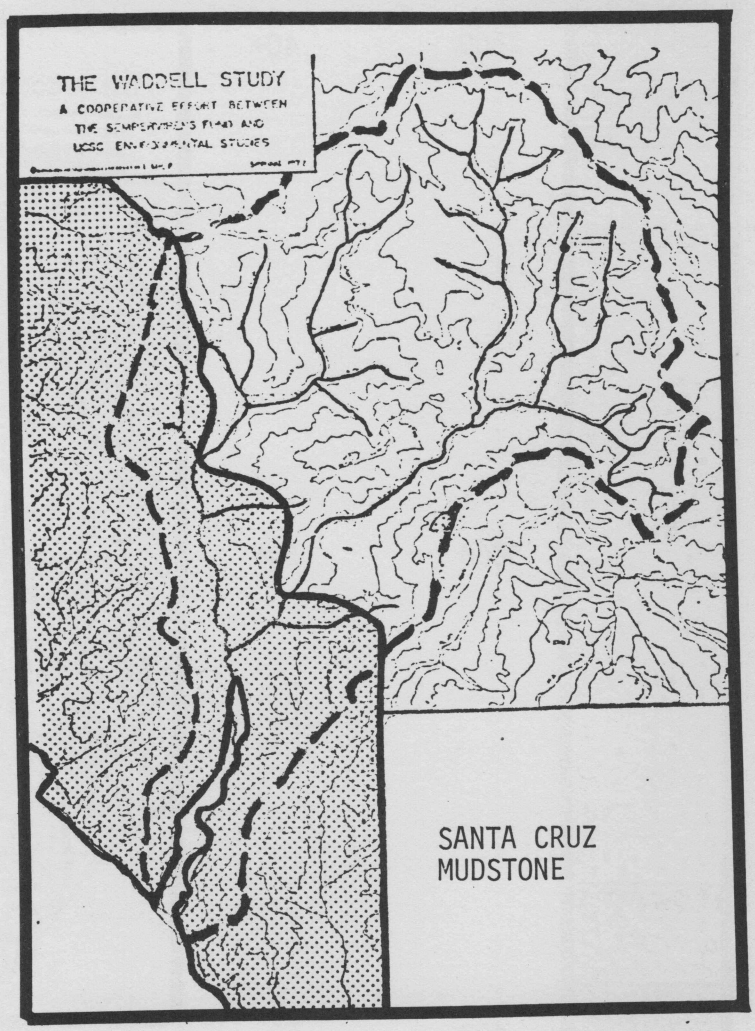
Tv: Vaqueros sandstone

Tsl: San Lorenzo Formation

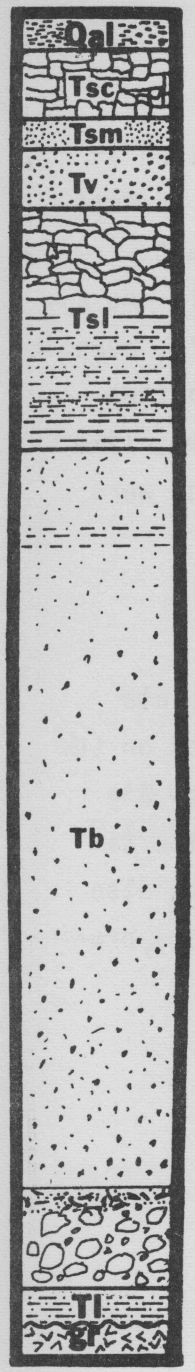
Tb: Butano sandstone

Tl: Locatelli Formation

gr: Granodiorite



The Santa Cruz mudstone, commonly called "chalkrock", is a blocky and massive white organic mudstone covering much of the coastal watershed. The diatomaceous mudstone also contains much phosphates. Its most characteristic feature is its weathering pattern of orange-brown concentric rings. Because it is extensively fractured, little rainfall is retained. Consequently, the rock holds little moisture or build-up of soil, and vegetation along the ridges of the watershed is limited to coastal scrub and chaparral species characteristic of an arid environment.



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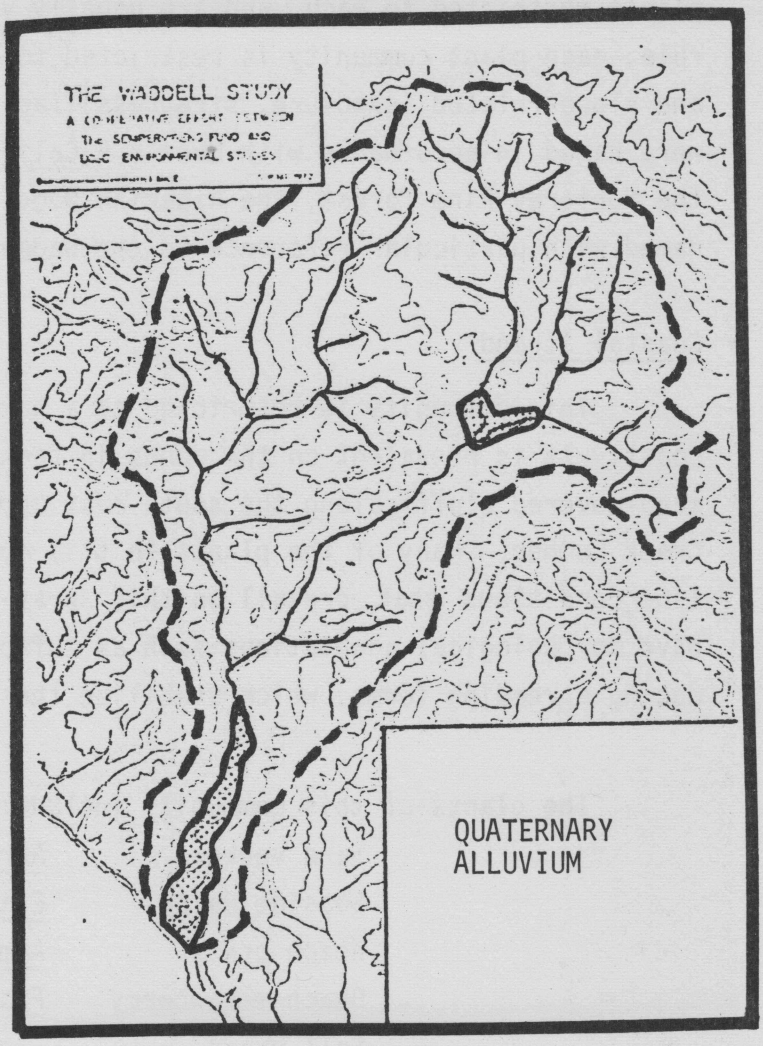


Quaternary alluvium consists of sediments eroded from different formations throughout the watershed. Most of the alluvium, or valley fill, was probably deposited following the Pleistocene ice ages when the sea levels were much higher, back-filling much of the Waddell drainage.

THE MAJOR PLANT COMMUNITIES OF THE WADDELL DRAINAGE

Introduction

The descriptions of the following plant communities were arrived at by observing the watershed vegetation as a whole, then splitting it up into vegetatively distinct areas. These areas have at least a few dominant plants restricted to each, and are usually visually distinct as well. As a rule, each plant community is restricted to areas of certain climatic, edaphic and slope-related (exposure, steepness) factors. Most of the communities were named in accordance with Munz's A California Flora; however some, like the Monterey Pine Forest, the Riparian Woodland, and the Pastureland, were named with particular reference to the Waddell area.

Coastal Strand

This community is restricted to a narrow belt along the immediate coast. It is prevalent on the dunes in back of the Waddell Beach and on the sand-covered bluffs along the south-east approach of Highway 1, below Big Creek Lumber. Many of the plants in this community are adapted to the saline conditions that prevail on this spray-swept strand. The plants also have morphological adaptations such as tufted forms or stolon (runner), producing spreading forms, which stabilize the shifting sands.

The plants of this community include:

Sand verbena	Abronia umbellata
Seaside daisy	Erigeron glaucus
Beach grass	Ammophila arenaria
Beach strawberry	Fragaria chiloensis
Salt grass	Distichlis spicata
Cord grass	Spartina foliosa
Plantain	Plantago maritima
Beach primrose	Oenothera cheiranthifolia
Sea rocket	Cakile maritima
Wallflower	Erysimum franciscanum
Bush lupine	Lupinus arboreus

Northern Coastal Scrub-Sage Community

A dry, densely covered, shrubby vegetation type is prevalent on the slopes near the mouth of Waddell Creek. This strip exists in a narrow elevational range from sea level to about five hundred feet where it grades rather abruptly into the Monterey Pine forest. In many areas of Northern California this community occupies the position between the Beach Stand and the Redwood Communities. This area generally receives about 15 to 25 inches of rain each year as well as frequent fog. There is little temperature fluctuation from season to season and the growing period may be 12 months long, with less than 50 frosty days per year. The growth form is low (about 6 feet) and highly sculptured by the wind, and almost totally impenetrable by man and other large mammals. The species that compose this community include:

THE FERNS:	
Bracken	Pteridium aquilinum var. pubescens
Goldenback	Pityrogramma triangularis
Swordfern	Polystichum munitum
Woodfern	Dryopteris arguta
Leather leaf	Polypodium Scouleri
California polypody	P. californicum
THE SHRUBS:	
Coffeeberry	Rhamnus californica
Western blackberry	Rubus vitifolius
California sage-brush	Artemesia californica
Poison oak	Rhus diversiloba
Coyote brush	Baccharis pilularis
Bush lupine	Lupinus arboreus
Elderberry	Sambucus mexicana
California lilac	Ceanothus thyrsiflorus
Bush monkey flower	Mimulus aurantiacus
Wild cucumber	Marah fabaceus

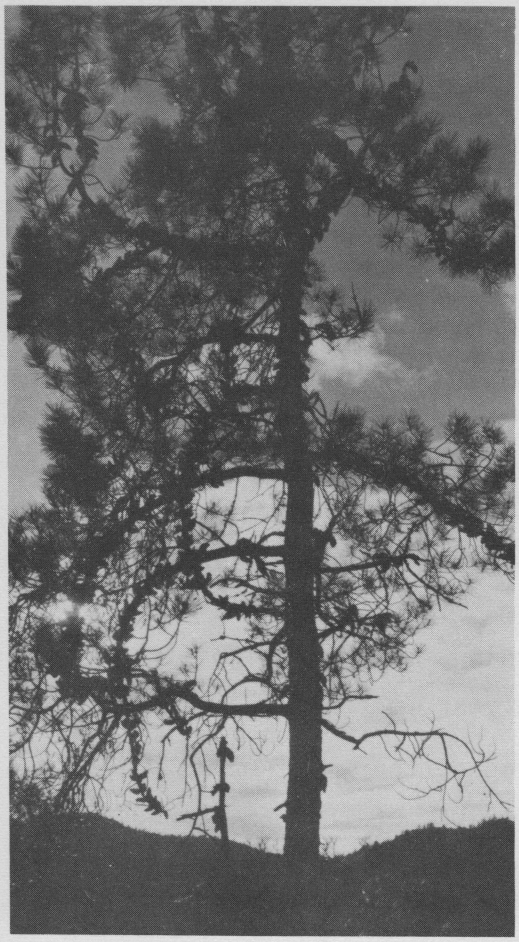
THE HERBS:

Stinging nettle	Urtica californica
Poison hemlock	Conium maculatum
Indian paintbrush	Castilleja latifolia
Lizard tail (Golden yarrow)	Eriophyllum staechadifolium
Figwort	Scrophularia californica
Cow parsnip	Heracleum lanatum
Climbing bedstraw	Galium nuttallii
American vetch	Vicia americana
Bull thistle	Cirsium vulgare
Live-forever	Dudleya farinosa
Wild buckwheat	Eriogonum latifolium

Monterey Pine Forest

This community is quite unique, as Monterey pines are native to only three locations in California. The forest is fairly extensive, climbing up the ridges flanking both sides of the mouth of Waddell Creek. It is drenched in fog during the dry months of summer and the under-story shrubs and herbs are a mixture of the plants from the coastal scrub (on the lower and more shaded slopes), mixed evergreen, and chaparral (on the higher ridge tops). This forest seems to be restricted to more exposed, coast-facing ridges and slopes and is replaced by Douglas fir and redwoods in the deep ravines. The forest only extends inland a fairly short distance before thinning out and grading into the hard chaparral, broad-leafed evergreen, and other communities. On ridges below the Chalks there are trees that exhibit some of the characteristics of both the Monterey and knobcone pines; these are thought to be hybrids. The forest floor is somewhat less shaded than the redwood forest floor and appears to be drier perhaps due to the steep, well-drained slopes that the forest occupies. Associated species include:

Douglas fir	Pseudotsuga Menziesii
Coffeeberry	Rhamnus californica
Coast live oak	Quercus agrifolia
Knobcone pine	Pinus attenuata



Knobcone Pine

Poison oak	Rhus diversiloba
Blue witch	Solanum umbelliferum
Man-root	Marah fabaceus
California blackberry	Rubus vitifolius
Bush monkey flower	Mimulus aurantiacus
Blue bush	Ceanothus thyrsiflorus
Ocean spray	Holodiscus discolor
Toyon	Heteromeles arbutifolia
Bracken fern	Pteridium aquilinum
Coastal woodfern	Dryopteris arguta
Goldenback fern	Pityrogramma triangularis
California maiden hair fern	Adiantum jordanii
Yerba santa	Eriodictyon californica
Yerba buena	Satureja Douglasii
Hedge nettle	Stachys ajugoides
American vetch	Vicia americana
Toothwort	Dentaria californica
Sweet-scented bedstraw	Galium aparine
Canyon gooseberry	Ribes manziesii
Giant trillium	Trillium chloropetalum

Freshwater Marsh

The marsh at the mouth of the valley was brackish until the dam for the fish hatchery was built. Before the dam, there was tidal influence up to a mile upstream, and perhaps then it could have been termed a lagoon or estuary. Due to the additional flooding of the surrounding pastureland following the damming, typical marshland species are increasing. In addition to this marsh along the creek there is a small isolated tule marsh on the south side of the road to the McLean house. This small marsh is dominated by common tule (Scirpus acutus) and California bullrush (Scirpus californicus). It apparently has existed there for a long time, as evidenced by the thick growth of mature arroyo willow (Salix lasiolepis) along its shore. This marsh is inhabited by Western pond turtles and two species of rails

have been seen here. The broader wetlands are bordered by several old stream channels, which are lined with riparian growth. Some of the common species of this area include:

Bullrush and tule	Scirpus spp.
Sedge	Carex spp.
Rush	Juncus spp.
Cattail	Typha latifolia
Silver-weed	Potentilla Egedei var. grandis
Brass button	Cotula coronopifolia
Water smartweed	Polygonum punctatum

Marshes illustrate successional changes well because in a relatively short time visible changes in the vegetation do occur. Therefore, this area, especially because of its recent additional flooding, may be a significant study area and warrants close observation from year to year.

Although not in the Waddell drainage proper, the small marsh near the beginning of Last Chance Road houses a larger number of fresh-water species than does the marsh at the mouth of the creek. Perhaps this is due to the more constant level of water. The marsh is almost entirely filled with emergent plants (cattails and tules, etc.) but there is a small portion of open water that is partially covered by floating aquatics. The marsh is surrounded by coastal prairie except for a small border of coastal scrub on the eastern side. Though the marsh is used by cattle, its borders have not suffered too noticeably. There are many border species, including:

Common monkey flower	Mimulus guttatus
Rush	Juncus effusus var. pacificus
Sedge	Carex spp.
American brooklime	Veronica americana
Silver-weed	Potentilla Egedii var. grandis
Water hemlock	Cicuta Douglasii
Spike rush	Heleocharis acicularis
Boisduvalia	Boisduvalia densiflora
St. Johns wort	Hypericum anagalloides

Floating Aquatics include:

Water buttercup	Ranunculus aquatilis var. capillaceus
Duckweek fern	Azolla filiculoides
Pondweed (2 spp.)	Potamogeton pectinatus, P. natans

Emergents:

Mares tail	Hippuris vulgaris
Flowering quillwort	Lilaea scilloides
Water starwort (several spp.)	Callitriche spp.

Riparian Woodland

This community lines the banks of Waddell Creek from the marsh until the stream forks, and in a modified form, well up into the redwood-Douglas fir areas of the upper drainage. The trees of this community are mostly deciduous, forming a dense shady canopy over the creek in the spring and summer.

This canopy includes:

Broad leaf maple	Acer macrophyllum
Red alder	Alnus oregona
Black cottonwood	Populus trichocarpa
Arroyo willow	Salix laevigata
Box elder	Acer negundo spp. californicum
California nutmeg	Torreya californica

Shrubs include:

Canyon gooseberry	Ribes menziesii
Straggly gooseberry	R. divaricatum
Thimbleberry	Rubus parviflora
Blackberry	Rubus vitifolius
Salmonberry	Rubus spectabilis var. franciscanus
Osoberry	Osmaronia cerasiformis
Red elderberry	Sambucus callicarpa
Giant chain fern	Woodwardia fimbriata

Herbs include:

Common scouring-rush	Equisetum hyemale
Giant horsetail	Equisetum Telmateia var. Braunii
Bleeding heart	Dicentra formosa
Western coltsfoot	Petasites palmatus
Fat solomon	Smilacina racemosa var. amplexicaulis
Giant trillium	Trillium chloropetalum
Elk clover	Aralia californica

The Riparian community changes somewhat as it moves upstream into the dense redwood forest. Here the deciduous canopy decreases and such shrubs as Western azalea (Rhododendron occidentale) and Western staff tree (Euonymus occidentalis) become more abundant along with panther lily (Lilium pardalium), five-finger fern (Adiantum pedatum), alum-root (Heuchera micrantha), and inside-out flower (Vancouveria planipetala).

Pastureland/Coastal Prairie

There are several areas in the Waddell flood plain near the coast that are covered by grasses and other herbaceous growth. These tracts are for the most part unnatural, the original vegetation having been cleared away for cultivation of crops or grazing and having been replaced by a predominantly ruderal non-native association. Before the development of the coast, there were extensive open areas perhaps best termed coastal prairies. An altered example occurs on Last Chance Road. These areas originally contained many bunch grasses and various flowering herbs but now, with the advent of grazing, many of these native plants have been replaced by more adaptable introduced Old World annuals. These same plants are specially adapted to the effects of the cutting hoofs and close cropping by cattle. Grasses are adapted to grazing because unlike many dicots they will grow back quickly. Also many of the plants in this association have deep tap roots or are annuals so that they will come up year after year even if the area is heavily trampled by grazers. Some of the plants here include various species of Hordeum, Avena, Festuca, and Danthonia, as well as English

plantain (Plantago lanceolata), fiddleneck (Amsinckia intermedia), morning glory (Convolvulus cyclostegius), Geranium, and Erodium. The borders of this community are usually alterns on the coastal scrub, riparian woodland, or broad leafed evergreen communities.

Along the lower reaches of Last Chance Road is a portion of open grassland that may be termed as coastal prairie. Although this area is also covered with many non-native annual grasses and herbs, there are many native herbs interspersed among the grasses including:

Brodiaea	B. elegans
Blue-eyed grass	Sisyrinchium bellum
Sky lupine	Lupinus nanus
Checker	Sidalcea malvaeflora
Coast tarweed	Hemizonia corymbosa
Eryngium	E. armatum
Johnny jump-up	Viola pedunculata
California poppy	Eschscholzia californica
Hairy oxalis	Oxalis pilosa
California buttercup	Ranunculus californicus
Red maids	Calandrinia ciliara
Star tulip	Calochortus uniflorus
Horkelia	Horkelia californica
Golden eggs	Oenothera ovata

Other non-native herbs include:

English plantain	Plantago lanceolata
Filaree	Erodium spp.
Hairy cats-ear	Hypochoeris radicata
Bur clover	Medicago hispida
Wild radish	Raphanus sativus
Sheep sorrel	Rumex Acetosella
Milk thistle	Silybum Marianum

Chaparral

The chaparral association is for the most part a fire-type formation

and shows evidence of long-term fire ravage.

Many areas on the Chalks have been burned fairly recently (charred stumps on ridge-top north of Picnic Point, etc.). These slopes lie above the region of most fog and therefore are subject to very hot-dry weather during much of the summer, spring, and fall. Many of the plants of the chaparral are specially adapted to withstand fire and hot, dry weather. Such plants as certain manzanitas (Arctostaphylos crustacea, A. Andersonii), chamise (Adenostoma fasciculatum), etc. have basal burls, which will quickly resprout after a fire. The knobcone pine (Pinus attenuata) will only disperse its seeds from its resin-filled cones after it has been bathed in fire or during extremely hot weather. Plants such as the canyon oak (Quercus chrysolepis), manzanitas, chamise, toyon (Heteromeles arbutifolia), wild lilac (Ceanothus spp.), etc. all have broad-evergreen sclerophyllous leaves (thick cuticle to reduce transpiration), which are well adapted to the dominantly hot, dry climate. Pine Mountain was also fairly recently burned over and has a very dense stand of young knobcone pines, which until recently were impenetrable even to deer. Dense stands of chaparral are very common on the drier slopes throughout California. The vegetation is for the most part shrubby growth usually not over 10 feet tall. It offers shelter to a number of birds and mammals. Common plants of the chaparral on the Chalks include:

Knobcone pine	Pinus attenuata
Bush poppy	Dendromecon rigida
Huckleberry	Vaccinium ovatum (usually not found in chaparral)

The manzanitas:

	Arctostaphylos Andersonii
	A. nummularia var. sensitiva
	A. crustacea
Chamise	Adenostoma fasciculatum
Canyon oak	Quercus chrysolepis
Bush chinquapin	Chrysolepis chrysophylla var. minor
Rock rose	Helianthemum scoparium
Yerba santa	Eriodictyon californica
Toyon	Heteromeles arbutifolia

Bush monkeyflower	Mimulus auranticus
Silk tassle	Garrya elliptica

A much more diverse chaparral exists on and near the top of Eagle Rock. In addition to the aforementioned species this area includes the rare Santa Cruz cypress (Cupressus abramsiana), as well as such shrubs as:

Golden fleece	Haplopappus arborescens
Yellow yarrow	Eriophyllum confertiflorum
Black sage	Salvia mellifera
Pitcher sage	Lepechinia calycina
Buck brush	Ceanothus cuneatus
Coast white-thorn	Ceanothus incanus
Warty-leaved ceanothus	Ceanothus papillosus
Chaparral pea	Pickeringia montana
California mountain mahogany	Cercocarpus betuloides
California sagebrush	Artemesia californica
California honeysuckle	Lonicera hispidula var. vacillans
Wild clematis	Clematis lasiantha

The herbs of this area include:

Scarlet larkspur	Delphinium nudicale
Indian warrior	Pedicularis densiflora
Broad-leafed lotus	Lotus crassifolius
Coyote mint	Monardella villosa
Henderson's shooting star	Dodecatheon hendersonii
Pacific stonecrop	Sedum spathulifolium
Indian paintbrush	Castilleja foliolosa
Hog fennel	Lomatium spp.
Live-forever	Dudleya cymosa

Redwood-Douglas Fir Forest

This community covers most of the shaded ravines, gulches, and stream bottomlands away from the immediate coast. The forest is heavy and dense,

the plants of the forest floor receiving very little sunlight, and very often growing in deep litter. The forest is bathed in fog during much of the year and is quite restricted (in the Waddell) to the regions that receive fog. The Douglas fir (Pseudotsuga menziesii) is a more widespread and opportunistic species found on higher, more exposed slopes than the redwood (Sequoia sempervirens) and often colonizing road-cuts and burned or logged-over areas. The redwood does not seed as readily and reproduces for the most part by sprouting, thus maintaining its stands but not expanding them significantly.

Other trees that are frequently associated with this community include wax myrtle (Myrica californica), tan oak (Lithocarpus densiflora), and where this community blends with the broad-leaf evergreen community, such trees as interior live oak (Quercus Wislizenii), California bay (Umbellularia californica), and madrone (Arbutus menziesii) occur.

Shrubs in the redwood-Douglas fir community include huckleberry (Vaccinum ovatum), thimbleberry (Rubus parviflora), sword fern (Polystichum munitum), snowberry (Symphoricarpos mollis), California hazel (Corylus rostrata var. californica), and in more open areas, poison oak (Rhus diversiloba) and blue bush (Ceanothus thyriflorus).

Many of the herbs found in the redwoods are restricted almost completely to them. These include:

Redwood sorrel	Oxalis oregona
Wild ginger	Asarum caudatum
Slinkpod	Scoliopus bigelovii
Red clintonia	Clintonia andrewsiana
Redwood violet	Viola sempervirens
Hedge nettle	Stachys bullata
Trail plant	Adenocaulon bicolor
Striped coral-root	Corallorhiza striata
Spotted coral-root	Corallorhiza maculata
Western wake-robin	Trillium ovatum
Modesty	Whippleya modesta

Fat solomon	Smilacina recemosa var. amplexicaulis
Fairy bells	Disporum hookeri

Because of the denseness of the canopy the forest floor is relatively shaded. This results in a relatively non-diverse biota.

Broad-Leaf Evergreen Forest

This community is found as islands within the redwood-Douglas fir community or along its inner edge (bordering on openings) or on the higher slopes above it. The broad-leaf evergreen forest is made of medium to large trees including:

Madrone	Arbutus menziesii
Tan oak	Lithocarpus densiflora
California bay	Umbellularia californica
Broad-leaf maple	Acer macrophyllum
Canyon oak	Quercus chrysolepis
Interior live oak	Quercus Wislizenii
Coast live oak	Quercus agrifolia
Douglas fir	Pseudosuga menziesii

On the steeper, more sheltered slopes the Douglas fir dominates this community, sometimes in such dense and pure stands that we feel we should perhaps term this a separate community. However, the other major constituents are essentially the same (shrubs and herbs) as the typical broad-leaf community.

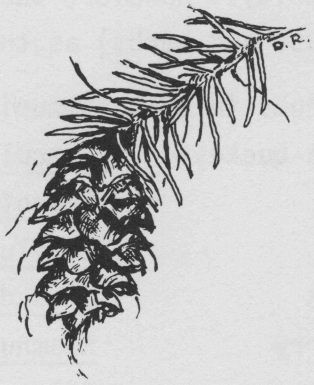
Other trees and shrubs in this community include:

California buckeye	Aesculus californica
Blue bush	Ceanothus thyrsiflorus
Hazel	Corylus rostrata var. californica
Poison oak	Rhus diversiloba
Coffee berry	Rhamnus californicus
Blue witch	Solanum umbelliferum
Bush monkey flower	Mimulus auranticus
Honeysuckle	Lonicera hispidula var. vacillans
Snowberry	Symphoricarpos mollis
Blackberry	Rubus vitifolius

Herbs include:

Star lily	Zygadenus Fremontii
Toothwort	Dentaria californica
Hound's tongue	Cynoglossum grande
Checker lily	Fritillaria lanceolata
Common madia	Madia elegans
Sweet cicely	Osmorhiza chilensis
Gamble weed	Sanicula crassicaulis
Yerba buena	Satureja douglasii
Wood fern	Dryopteris arguta
Iris	Iris douglasii, Iris macrosiphon
Globe lily	Calochortus albus
Milkwort	Polygala californica
American vetch	Vicia americana
Miners' lettuce	Montia perfoliata
Birdsfoot	Lotus spp.

As in the chaparral, many of the trees and shrubs in this community exhibit the same sclerophyllous leaf type, an adaptation to seasonal drought. This community is often in close association with the redwood-Douglas fir forest and shares many of the same species. There are large ecotonal areas where the boundaries of the two communities are hard to delineate.



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Thomas, John. A Flora of the Santa Cruz Mountains. Stanford Press, Palo Alto, 1966.

BIRDS OF THE WADDELL DRAINAGE

Introduction

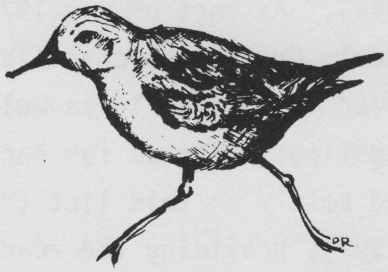
The composite checklist of birds is intended as a guide to the birds that have been observed in the Big Basin watershed since 1930. Besides being a historical compendium, the checklist gives a general picture of when and where currently occuring species are most likely to be found, as well as when they were last listed.

Brief observations in the spring of 1971, coupled with 16 days of more extensive field work between January 29 and May 30, 1972, have been supplemented by information culled from Robert T. Orr's report on the birds of the Big Basin region (Orr, 1942). As most of the 1972 observations included the marsh at the mouth of Waddell Creek, the checklist for Rancho del Oso compiled by Hulda McLean proved very valuable as well. The Rancho del Oso checklist, composed of sightings going as far back as 1930, contains many species that are mentioned solely on this list (species with an "R" under the heading "last listed by"), providing the reader with interesting information on the great variety of birds that have wandered into or inhabited this diverse, relatively undisturbed area at some time in the past. Since the Rancho del Oso list is made up of reports from a wide range of years, it was arbitrarily decided to use that checklist as our starting point, and all other sources are considered to post-date it.

Additional important information was extracted from reports on the annual fall field trips to Rancho del Oso by members of the Santa Cruz Bird Club, published in the Club's bi-monthly bulletin, The Albatross. These trips took place on the following dates, and would appear under "last listed by" as SC f 65, SC f67, etc.:

1965	Oct. 16
1966	Oct. 16
1967	Oct. 12
1968	Sept. 28
1969	Oct. 21
1970	Oct. 7
1971	Sept. 25
*	Seen only once or twice

The bird list given by Don Meadows in his report on the natural history of Big Basin Redwoods State Park (Meadows, 1950) was also used as a source.



WADDELL CREEK DRAINAGE BASIN
Composite Checklist of Birds--1930 to Present

KEY

*	Seen only once or twice
(72)	First listed 1972
R	Rancho del Oso checklist (1930-1966), plus recent additions given as R(year)
SC	Santa Cruz Bird Club list, from one-day field trip
f(year)	Fall of the year given
s71, w72, s72	Last listed in authors' field notes: Spring 1971, Winter 1972, Spring 1972
Meadows	Last listed by Don Meadows (1950)
Orr	Last listed by Robert T. Orr (1942)

	Seasonal Status	Where Most Likely Found	Last Listed
COMMON LOON	winter visitant	open ocean	R
ARCTIC LOON	winter visitant	open ocean	SC f68
RED-THROATED LOON	winter visitant	open ocean	SC f69
RED-NECKED GREBE*	winter visitant	open ocean	SC f69
PIED-BILLED GREBE	resident	marsh	s72
WHITE PELICAN			R
BROWN PELICAN		open ocean	SC f68
DOUBLE-CRESTED CORMORANT	irregular visitant	open ocean	SC f69
BRANDT'S CORMORANT	common visitant	open ocean	SC f69
PELAGIC CORMORANT	common visitant	open ocean	SC f69
GREAT BLUE HERON	resident	marsh	s72
GREEN HERON	transient	marsh	s72
COMMON EGRET	irregular visitant		s71
AMERICAN BITTERN			R
WOOD IBIS*			R
CANADA GOOSE			R
SNOW GOOSE			R
MALLARD	common resident	marsh	s72

	Seasonal Status	Where Most Likely Found	Last Listed
KILLDEER	possible resident	marsh	s72
BLACK-BELLIED PLOVER	migrant	beach, marsh	SC f69
SURFBIRD*	migrant		SC f69
BLACK TURNSTONE	infrequent visitant		SC f69
COMMON SNIPE			R
SPOTTED SANDPIPER (72)	irregular visitant	marsh	s72
WANDERING TATTLER*			SC f69
WILLET	common visitant	beach	SC f70
GREATER YELLOWLEGS (72)	migrant	marsh	s72
KNOT	migrant		SC f69
LEAST SANDPIPER (72)	migrant	beach, marsh	s72
DUNLIN			R
LONG-BILLED DOWITCHER	migrant	marsh	s72
WESTERN SANDPIPER	migrant	beach, marsh	Orr
MARBLED GODWIT	fall migrant	beach	SC f70
SANDERLING	migrant	beach	SC f69
NORTHERN PHALAROPE	migrant	marsh	s72
GLAUCOUS-WINGED GULL			SC f69
WESTERN GULL			SC f70
HERRING GULL			SC f69
CALIFORNIA GULL			SC f69
RING-BILLED GULL			SC f68
BONAPARTE'S GULL	migrant	overhead	s72
HEERMANN'S GULL			SC f70
COMMON TERN			R
ARCTIC TERN			R
CASPIAN TERN* (72)	migrant	overhead	s72 (April 22)
COMMON MURRE			SC f69
MARBLED MURRELET (72)			s72,Chico State
TUFTED PUFFIN*			R
BAND-TAILED PIGEON	common resident	redwood,Douglas fir	s72

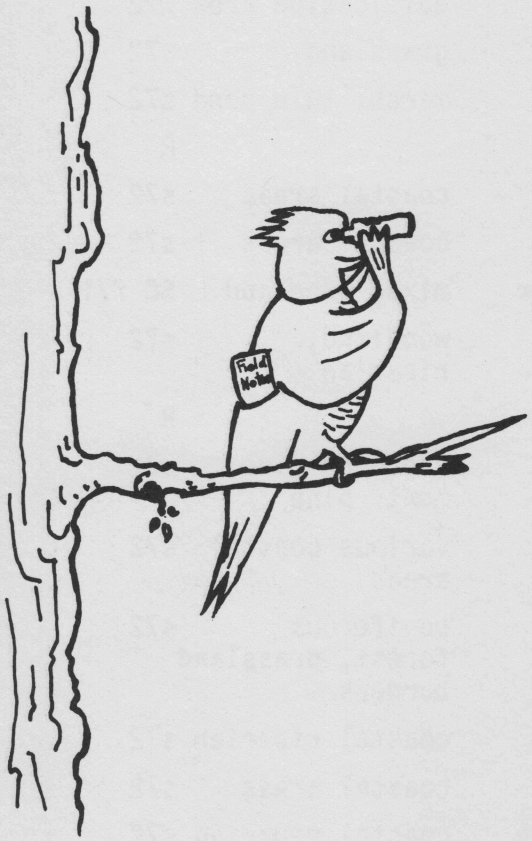
	Seasonal Status	Where Most Likely Found	Last Listed
ROCK DOVE* (72)		overhead	s72
MOURNING DOVE	summer resident	open areas	s72
YELLOW-BILLED CUCKOO*			R
ROADRUNNER*			R
BARN OWL	resident	barn	w72
SCREECH OWL	resident	mixed woodland	s72
GREAT HORNED OWL	resident	dense forest	s72
PIGMY OWL	probably resident	mixed woodland forest	s72
BURROWING OWL*			R
LONG-EARED OWL*			R
SAW-WHET OWL			R
POOR-WILL	summer visitant	chaparral ridges	Meadows
COMMON NIGHTHAWK			R
BLACK SWIFT			R
VAUX SWIFT	summer visitant	variable	s72
WHITE-THROATED SWIFT	possible resident	variable	s72
ANNA'S HUMMINGBIRD	resident	coastals scrub, chaparral	s72
RUFOUS HUMMINGBIRD			R
ALLEN'S HUMMINGBIRD	summer resident	coastal scrub, chaparral	s72
BELTED KINGFISHER	winter resident	creeks, marsh	w72
YELLOW-SHAFTED FLICKER*			R
PILEATED WOODPECKER	rare	coniferous and mixed forest	s72
ACORN WOODPECKER	resident	oaks	s72
YELLOW-BELLIED SAPSUCKER		woodlands, orchard	w72
HAIRY WOODPECKER	resident	coniferous forest mixed woodland	s72
DOWNY WOODPECKER	resident	coniferous forest mixed woodland	s72
NUTTALL'S WOODPECKER			SC f70
WESTERN KINGBIRD			R

	Seasonal Status	Where Most Likely Found	Last Listed
ASH-THROATED FLYCATCHER	summer resident	chaparral	Meadows
BLACK PHOEBE	resident	marsh, streams	s72
SAY'S PHOEBE	winter visitant	marsh, open fields	w72
WESTERN FLYCATCHER	summer resident	redwood-Douglas fir, woodland	s72
WESTERN WOOD PEWEE	summer resident	woodland	s72
OLIVE-SIDED FLYCATCHER	summer resident	forest, woodland	s72
VIOLET-GREEN SWALLOW	probably summer resident	variable; often seen at marsh	s72
TREE SWALLOW	spring migrant	marsh, valley	s72
BANK SWALLOW	spring, possibly summer visitant	marsh	s72
ROUGH-WINGED SWALLOW	spring, possibly summer visitant	marsh	s72
BARN SWALLOW	summer resident	marsh	s72
CLIFF SWALLOW	summer resident	marsh	s72
PURPLE MARTIN	summer visitant	higher ridges	Meadows
GRAY JAY			R
STELLER'S JAY	common resident	redwood, picnic areas	s72
SCRUB JAY	common resident	chaparral, oak-madrone	w72
COMMON RAVEN*	transient	flying over ridges	w72
CLARK'S NUTCRACKER			R
CHESTNUT-BACKED CHICKADEE	common resident	forest and wood-woodland	s72
PLAIN TITMOUSE			SC f67
COMMON BUSHTIT	common resident	woodland	s72
WHITE-BREASTED NUTHATCH	uncommon visitant	coniferous forest	SC 70
RED-BREASTED NUTHATCH	winter visitant	redwood-Douglas fir	SC 70
PYGMY NUTHATCH	common resident	coniferous for-est	s72
BROWN CREEPER	resident	redwood forest	w72

	Seasonal Status	Where Most Likely Found	Last Listed
WRENTIT	common resident	chaparral, coastal scrub	s72
DIPPER	resident	streams	SC 68
HOUSE WREN*			SC 71
BEWICK'S WREN	common resident	chaparral	s72
WINTER WREN	resident	redwood forest	SC 69
LONG-BILLED MARSH WREN	resident	tule-cattail patch in marsh	s72
CANYON WREN*			R
MOCKINGBIRD	transient	edification area near coast	s72
CALIFORNIA THRASHER	common resident	chaparral	s72
ROBIN	possible resident	forested areas	s72
VARIED THRUSH	winter visitant	forested areas	w72
HERMIT THRUSH	resident	forested areas	s72
SWAINSON'S THRUSH	possible summer resident	riparian	s72
WESTERN BLUEBIRD	resident?	knobcone pine, grassland	w72
GOLDEN-CROWNED KINGLET	resident	conifers	s72
RUBY-CROWNED KINGLET	winter resident	oak-madrone woodland	w72
WATER PIPIT			R
CEDAR WAXWING	winter resident	conifers, oak-madrone	SC f68
LOGGERHEAD SHRIKE	irregular visitant	open land	SC f68
STARLING	resident	edification area	s72
HUTTON's VIREO	common resident	oak-madrone woodland	s72
SOLITARY VIREO* (72)	transient/migrant?	mixed woodland	s72
WARBLING VIREO	summer resident	riparian, oak-madrone	s72
ORANGE-CROWNED WARBLER	summer resident	oak-madrone	s72
YELLOW WARBLER	summer resident	coastal riparian	s72
MYRTLE WARBLER	winter resident	riparian	s72
AUDUBON'S WARBLER	winter resident	riparian	w72

	Seasonal Status	Where Most Likely Found	Last Listed
BLACKTHROATED GRAY WARBLER	summer resident	chaparral	s72
TOWNSEND'S WARBLER	winter resident	woodlands, Douglas fir	w72
HERMIT WARBLER	uncommon		Meadows
MACGILLIVRAY'S WARBLER*	uncommon		Meadows
YELLOWTHROAT	resident	tule pond, marsh	s72
WILSON'S WARBLER	summer resident	forest, wood, riparian	s72
HOUSE SPARROW	uncommon	edification area	w72
WESTERN MEADOWLARK	common resident	grassland	s72
REDWINGED BLACKBIRD	common resident	marsh, tule pond	s72
BULLOCK'S ORIOLE*			R
BREWER'S BLACKBIRD	resident	coastal areas	s72
CROWN-HEADED COWBIRD	summer resident	coastal areas	s72
WESTERN TANAGER	uncommon, summer	mixed woodland	SC f71
BLACK-HEADED GROSBEAK	summer resident	woodland, riparian	s72
EVENING GROSBEAK			R
PURPLE FINCH	common resident	knobcone pine, mont. pine	s72
HOUSE FINCH	common resident	various coastal areas	s72
PINE SISKIN	common resident	coniferous forest, grassland borders	s72
AMERICAN GOLDFINCH	common resident	coastal riparian	s72
LESSER GOLDFINCH	resident	coastal areas	s72
LAWRENCE'S GOLDFINCH	infreq. spring & summer visitant	coastal riparian	s72
RUFOUS-SIDED TOWHEE	common resident	chaparral	s72
BROWN TOWHEE	resident	brushland	s72
SAVANNAH SPARROW*	uncommon	grassland, marsh	s72
LARK SPARROW	summer resident	grassland	s72
OREGON JUNCO	common resident	woodland, forest	s72
CHIPPING SPARROW	summer resident	eastern grassland	s72

	Seasonal Status	Where Most Likely Found	Last Listed
WHITE-CROWNED SPARROW	common resident	coastal scrub	s72
GOLDEN-CROWNED SPARROW	winter resident	coastal scrub	s72
FOX SPARROW	resident	woodland, chaparral	s72
SONG SPARROW	common resident	marsh border, riparian growth	s72



COMMENTS

Pied-Billed Grebe	Young pied-billed grebes were seen and photographed at the junction of the creek and the marsh on May 29, 1972.
Great Blue Heron	This species often nests in the Monterey pine stands near the marsh. A pair was seen flying together in the lower valley area on March 9 and again on April 12, 1972.
Wood Ibis	This record should be checked, as there are only four verified sightings of this species for Northern California since August of 1931 (McCaskie and De Benedictis, 1966).
Mallard	Young mallards were seen swimming in the creek area just north of the marsh on May 29, 1972.
Blue Winged Teal, Cinnamon Teal	The more common species, the cinnamon teal, was seen all winter in the marsh. Their numbers reached fifteen on April 9, dropping to 3 pairs by the end of the month. One nest was found in the middle of May. Cinnamon teal is not on the Rancho del Oso list, whereas the uncommon blue-winged teal is. It is possible that the two species were confused by the observer who recorded "blue-winged" teal.
Golden Eagle	The last resident pair was shot in the 1950's, according to Hulda McLean.
Barn Owl	The old barn back of the marsh has been the home of a succession of barn owls.
Great Horned Owl	A great horned owl was seen flying in the lower valley area in daylight on May 29 and again on May 30, 1972.
Black Swift	Reported to be breeding behind Berry Creek Falls (McCaskie and De Benedictis, 1966).
Pileated Woodpecker	Seen and heard by Jim Christman, a UCSC student, near the

	Big Basin Redwoods State Park Headquarters on May 24, 1972. Heard by Ginger and Todd Keeler-Wolf earlier in the month on Gazos Creek road, along the West Fork of Waddell Creek. We know of no other past sightings of this bird south of the Bay Area; it is not known to breed south of Sonoma and Napa counties (McCaskie and De Benedictis, 1966).
Swallow species	Violet-green, barn, and cliff swallows are known to breed in the lower valley. Violet-green and tree swallows were first seen on February 15, 1972, and three rough-winged swallows on March 5. On April 12, six of the seven swallow species (no purple martin was seen) found on the Pacific coast could be seen in the 75-100 swallows foraging over and around the marsh.
Green Jay (Oregon Jay)	This record should be verified. Current southern limit of its California range is Albion, Mendocino County (McCaskie and De Benedictis, 1966).
Lawrence's Goldfinch	Several individuals of this species were heard in the riparian growth adjacent to the old orchard, on the evening of May 30, 1972.

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MAMMALS FOUND IN THE WADDELL DRAINAGE

1) OPOSSUM Didelphis marsupialis: Woodlands, farming areas, and along streams in the valley. Not as common as once was. Sometimes found dead along roads. Native to eastern United States.

2) TROWBRIDGE SHREW Sorex trowbridgii: In wooded areas, redwood-Douglas fir forest. Secretive. Also in coastal scrub.

3) ORNATE SHREW Sorex ornatus: Near streams and wet meadows in the valley.

4) BROAD-HANDED MOLE Scapanus litimanus: In soft soils in valleys and meadows or pastureland. Throws up a line of dirt. Plugs its burrow.

5) SHREW MOLE Neuotricuus gibbsii: Rather rare. Moist areas, shady ravines along streams where ground is free of turf. Often above ground in deep redwood duff.

6) BATS: About 13 species are reported for the Waddell-Big Basin area, most are hard to differentiate while flying. The most common species include:

   a. CALIFORNIA MYOTIS Myotis californicus: Forages low near trees. Rarely 15 feet above ground.

   b. YUMA BAT Myotis yumanensis: Common in woodland areas of Waddell Creek drainage.

   c. LONG EARED MYOTIS Myotis evotis: In well forested redwood and mixed evergreen forests in Waddell.

   d. FRINGED MYOTIS Myotis thysanodes: Wooded areas of valley.

   e. LARGE BROWN BAT Eptesicus fuscus: Common in Waddell valley.

   f. RED BAT Lasiurus borealis: Seen flying over streams, mostly migrational (found in winter).

   Other BATS observed occasionally in the Waddell drainage include:

   g. LITTLE BROWN MYOTIS Myotis lucifugus.

   h. HOARY BAT Lasiurus cinereus: Migrational like the Red Bat.

   i. SILVERY HAIRED BAT Lasiouycteris noctivagans: Roosts in foliage trees.

   j. WESTERN PIPISTRELLA Pipistrellus hesperus: Pale smokey-grey body.

k. PALLID BAT Antrozous pallidus.

l. LUMP-NOSED BAT Plecotus townsendii.

m. BRAZILIAN FREE-TAILED BAT Tadarida brasiliensis: Tail about half-free from membrane.

7) BLACK-TAILED HARE Lepus californicus: Found in chaparral and in open grasslands but ventures into other communities as well. Not as common as once was.

8) AUDUBON COTTONTAIL Sylvilagus audubonii: In thickets of blackberry and other shrubs. Apparently not too common.

9) BRUSH RABBIT Sylvilagus bachmanni: Common in pastures and on slopes and rocky areas with scattered trees.

10) BEECHEY GROUND SQUIRREL Otospermophilus beecheyi: Common in pastures and on slopes and rocky areas with scattered trees.

11) MERRIAM CHIPMUNK Eutamias merrami: Fairly common in chaparral of the Chalks region. Also in mixed oak woods and rocky outcroppings.

12) EASTERN GREY SQUIRREL Sciurus carolinensis: Introduced in the Santa Cruz Mountains and found in Big Basin.

13) WESTERN GREY SQUIRREL Sciurus griseus: The common squirrel of the oaks and redwoods.

14) FOX SQUIRREL Sciurus niger: Introduced near the green cottage in the valley. Originally from the eastern United States.

15) BOTTA POCKET GOPHER Thomomys bottae: Common in the valley pastures. Prefers a loam soil.

16) CALIFORNIA POCKET MOUSE Perognathus californicus: On oak or chaparral covered slopes.

17) SANTA CRUZ KANGAROO RAT Dipodomys venustus: Slopes and flats with oaks, chaparral or pines.

18) WEATERN HARVEST MOUSE Reithrodontomys megalotis: Builds nests of grass, etc., in grassland, weed patches and dense vegetation near water.

19) CALIFORNIA MOUSE Peromyscus californicus: Common in chaparral and oak woodlands.

20) PINYON MOUSE Peromyscus truei: In chaparral. Often climbs shrubs.

21) DEER MOUSE Peromyscus maniculatus: Found in many communities including houses, barns, etc.

22) DUSKY-FOOTED WOOD RAT Neotoma fuscipes: Common in many communities. Builds conspicuous house of sticks, etc. on ground and even in trees.

23) CALIFORNIA MEADOW MOUSE Microtus californicus: Common in the valley pasture land, especially near the marsh. Builds runways through grass.

24) NORWAY RAT Rattus norvegicus: Around buildings in Big Basin and valley. Native of Old World.

25) BLACK RAT Rattus rattus: Same as above.

26) HOUSE MOUSE Mus musculus: Around human habitations but also in fields. Native of Old World.

27) GREY FOX Urocyon cinereoargenteus: Common, but secretive. In chaparral, rimrock and ridge country, and oak and mixed forests.

28) COYOTE Canis latrans: More commonly heard than seen. In valley, Last Chance Road area, and the Chalks.

29) RACOON Procyon lotor: Along streams, and marsh area. Footprints often seen in mud. Not as common as once was.

30) RINGTAIL Bassariscus astatus: Rocky and brushy places, often near water (Eagle Rock). Rather rare, but secretive.

31) LONG-TAILED WEASEL Mustela frenata: Found in all habitats, usually near water.

32) BADGER Taxidea taxus: In open fields and pasturelands (Last Chance Road). Feeds on ground squirrels and pocket gophers.

33) STRIPED SKUNK Mephitis methitis: Mixed woods and pastureland; fairly common.

34) SPOTTED SKUNK Spilogale putprius: In rocky and brushy places. Seen on beaches at night occasionally.

35) MOUNTAIN LION Felis concolor: Very rare in this area. However, tracks were seen several years ago on a ridge in the Chalks region.

36) BOBCAT Lynx rufus: Fairly common in nearly all communities. One was sighted this spring in broad daylight near the marsh.

37) MULE DEER Odocoileus hemiouus: Common in many communities. Often seen grazing in early morning and evenings with cattle in the pastures.

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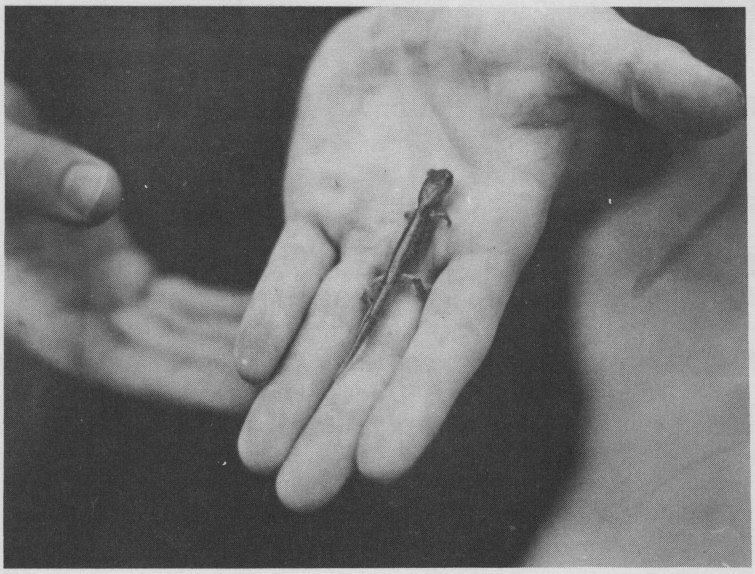
Conversations with Hulda McLean

Personal Observations



REPTILES AND AMPHIBIANS OF THE WADDELL DRAINAGE

1) WESTERN POND TURTLE: Found in the tule marsh on the southern end of the marsh, and below the dam on the marsh, wholly aquatic. More commonly seen in warmer months.

2) WESTERN FENCE LIZARD: Grasslands and open woods, especially near rock outcrops, brushtops and buildings.

3) WESTERN SKINK: Woodland forest, grassland, usually with leaf litter, rotting logs, rock piles.

4) NORTHERN ALLIGATOR LIZARD: Open grassland, woodland and chaparral, borders of heavy forest, in wood piles, brush heaps and shaded thickets under rocks and logs.

5) SOUTHERN ALLIGATOR LIZARD: Open grassland, woodland and chaparral, borders of heavy forest, in wood piles, brush heaps and shaded thickets under rocks and logs.

6) RUBBER BOA: Moist forest or woodlands often under small objects near clearings.

7) WESTERN RINGNECK SNAKE: Under logs, rocks, boards, etc. near woods, also in grasslands and gardens.

8) RACER: Grassland, open brushland. May eat birds.

9) SHARP-TAILED SNAKE: Rare, inside rotten logs, underground in woods, grassland and forest. Eats slugs.

10) COACHWHIP (RED RACER): Grassland and open brushland. May occur in small tracts of grassland and in redwood-douglas fir forest.

11) GOPHER SNAKE: Grasslands, woodlands, and chaparral. Common.

12) KING SNAKE: Woodland, grassland, and broken forest. Most common in warmer areas in rocky outcrops and bouldery stream courses in open woodland.

13) MOUNTAIN KING SNAKE: Chiefly in redwood-Douglas fir forest, rocky stream courses, wooded canyon bottoms and moist woods. Rare.

14) a. WESTERN GARTER SNAKE, SANTA CRUZ FORM: Aquatic, often in or near ponds, lakes and small streams, but the Santa Cruz form ranges widely on land.

b. WESTERN GARTER SNAKE: In meadows, brush covered hillsides (chapar-

ral and coastal scrub) and stream borders. Rarely enters water.

15) COMMON GARTER SNAKE: Meadows, marshes and thickets in or near water.

16) WESTERN RATTLESNAKE: Grassland, brushland, woodland and less dense parts of forests usually where there are rocks. Quite uncommon.

17) TIGER SALAMANDER: Near large rain pools, reservoirs and slowly flowing streams in grassland or woods. Season November - February. Not often seen in Waddell drainage.

18) PACIFIC GIANT SALAMANDER: Permanent streams and humid streamside forests. Larval forms common in streams. Found all year.

19) CALIFORNIA NEWT: Streamside woodland. When breeding (December - May), in streams, ponds, and reservoirs.

20) ROUGH-SKINNED NEWT: Habitat similar to California Newt but breeding in December - July.

21) ENSATINA: Coast redwood and Douglas fir forest. Also in oaks and coastal scrub. Season: October - April.

22) CALIFORNIA SLENDER SALAMANDER: In oak and redwood. Season: October - June.

23) ARBOREAL SALAMANDER: Under logs, etc. in coast live oak woods. October - June and all year in watered areas.

24) BLACK SALAMANDER: Wet soil among rocks, along streams, and in wooded areas.

25) WESTERN TOAD: Drier grassy areas and woodlands. Breeds March - May.

26) PACIFIC TREEFROG: Common in marsh and surrounding grasslands.

27) RED-LEGGED FROG: Found in marsh. Breeds January - March.

28) YELLOW-LEGGED FROG: Along rocky streams. Breeds February - May.

29) BULLFROG: Introduced in California. In marsh. Breeds March - July.

30) LEOPARD FROG: Introduced in marsh on Last Chance Road. Breeds March - July.

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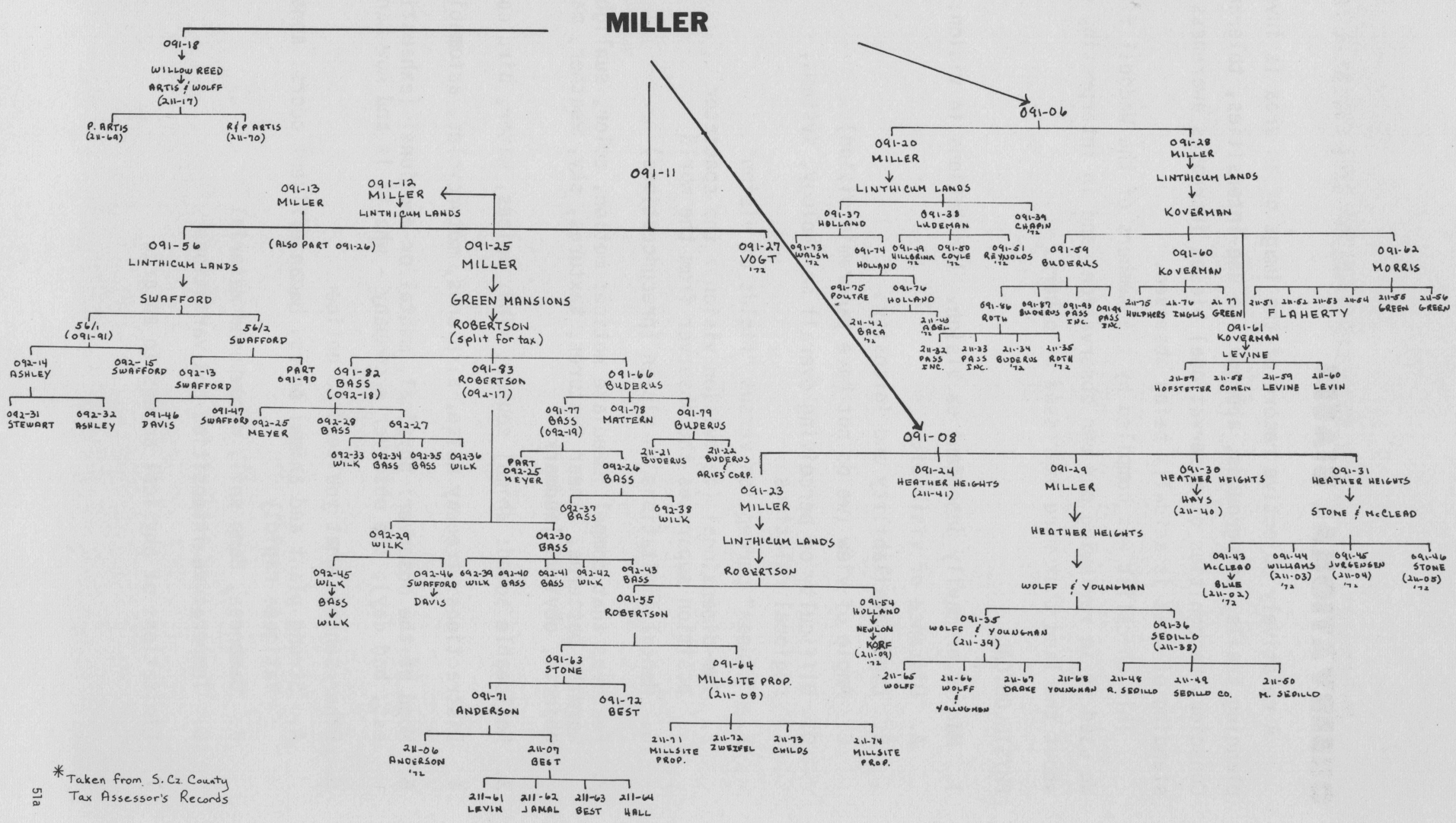
PROPERTY AND OWNERSHIP INFORMATION

As recreation areas become more crowded and the demand for second-home sites grows, large tracts of land are divided to meet these demands. An informal type of subdivision, known as "lot-splitting", has been widely used in rural California to create recreation lots, usually unimproved. Since local planning and public works authorities are generally not consulted during the splitting and sale of these lots, conflicts with public land use policy tend to be aggravated.

A lot-split subdivision is currently being created in the East Fork area of the Waddell, an area which the State Park system hopes to acquire. During our research, we attempted to unravel the complex history of land ownership in the East Fork. As a result, we derived this "genealogical chart" of land division, which traces the ownership patterns from the 1950s - when the land was held by one person - to the highly subdivided land map of today. Santa Cruz County Assessor's parcel numbers (June, 1972) are given for each plot.

GENEALOGY OF THE LAST CHANCE LOT-SPLIT SUBDIVISION



*Taken from S. Cz. County Tax Assessor's Records

OBSERVATIONAL BIASES

A relatively objective record of the image of an area is invaluable in planning trails, campgrounds, appropriate use-intensities, tolerances, etc. Conscious recognition of observational biases increases awareness and understanding of what is actually being observed.

This checklist was compiled by the members of the Waddell field team. We used it in reviewing our own observations and in interpreting comments about the land that were expressed by others.

PHYSIOLOGICAL

1. Man is primarily dependent on vision. Limitations in vision:
   A. Distance of visibility
   B. Light availability and intensity
   C. Angle of view (we do not have panoramic vision)
   D. Difficulty of perceiving overall morphology, systems, regional relations
   E. "Linear" perception versus "fields of vision"
   F. Two-dimensional (television vision): the spectator position separates the observer from the world
   G. Mental limitations on vision (preconceptions)
2. Features that compel immediate notice: motion, color, sunlight and warmth, patterns, linear features, textures, sky, weather, man-made objects, obvious landmarks
3. Noticeable sound: animal sounds, wind, voices, water, bird calls, etc.
4. Distractions: freeway noise, airplanes, motorcycles, automobiles, etc.
5. Mood of the observer: physical, mental or emotional (exhaustion, interest, bad day); the observer's company - who it is and how many there are
6. Other senses: what you tend to notice
   A. Strong plant and animal odors, human effluent odors: sense of smell fatigues rapidly
   B. Dampness, damp soil, decomposed material
   C. Temperature intensities and variations
7. Limitations of physical access to an area

CULTURAL AND ACADEMIC

1. Preconceptions come from the narrowing, limiting and defining imposed by culture and academia. We tend to look for something in particular - you "see what you're looking for" - and notice something of direct usefulness.
   A. Judgments on what we observe are based on ackowledged criteria of beauty, social worth, economic value, scientific value.
   B. Specialization: Personal viewpoint (looking as a botanist, bird watcher, hiker, engineer, realtor) determines what we look for and see and how we interpret what we see (the subjectiveness of seeing what is important to us).
   C. Predispositions of likes and dislikes: (judgments of good and bad) we are open to those things beautiful and pleasurable, try to block out those that are displeasing.

2. Academic orientation tends toward an intellectual awareness: identification and classification, which may be limiting. However, knowledge, either academically learned or lived through, tends to increase and deepen an understanding that could not be perceived just through the senses.

3. Limitations of language, imposing bias first into our conceptions and then into our expression of ideas.

4. Man is limited in perceiving various scales of time and distance and can only comprehend a narrow range of complexity.
   A. Time: We need an expanded time orientation and need to learn to see things in terms of past and future as well as present. But a deep, present orientation is needed first to create many levels of awareness.
   B. Inability to see change, the dynamics of life, to perceive the flow.

5. Man, as a terrestrial animal, is terrestrially oriented.

6. The anthropomorphic view: lack of empathy with other lifeways.

"Observation seems to start out by sight first and then gradually, by listening (need a lot of quiet inside your head first to know when you're not hearing anything), and then by smells and the feel of the air and winds, and more totally involving all the sense: that seems very important."

"Our academic training tends to stress objectivity above all else: remember when to be subjective."

"We tend to comfortably assume that a place or thing will continue as it is because we see (smell, hear, feel) it that way now. We must learn to see

things not only in their present state of being, but in the past and future states as well."

"We have moved from contact with our environment and isolate our souls in unnatural settings of steel and concrete. It all becomes a matter of media."

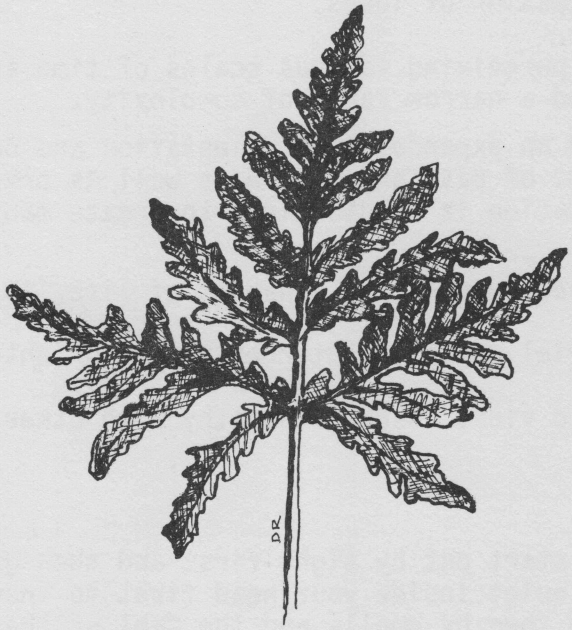
"But only with God, good luck, intuition, and experience can the observer also sense where he is, where and how he fits into a particular scene, how he is being affected, how he affects the environment."

To See

It's a question of seeing
so much clearer,

of doing to things
what light does to them.

Guillevic



STATE OF CALIFORNIA—RESOURCES AGENCY RONALD REAGAN, Governor

DEPARTMENT OF PARKS AND RECREATION
P.O. BOX 2390
SACRAMENTO 95811

March 21, 1973

Berry Hecht
California Health Center
U.C. Santa Cruz
Santa Cruz, California 95060

Dear Mr. Hecht:

This is in answer to you request for annual visitor attendance at Big Basin Redwoods SP.

71/72	805,180	1958	553,153
70/71	807,186	1957	567,815
69/70	1,321,229	1956	535,501
68/69	1,225,238	1955	584,688
67/68	864,741	1954	569,927
66/67	565,318	1953	436,703
65/66	651,619	1952	425,951
64/65	662,664	1951	523,572
63/64	741,322	1950	461,630
62/63	823,585	1949	454,295
61/62	773,779	1948	422,410
1961	885,377	1947	593,660
1960	660,388	1946	450,125
1959	692,422		

Enclosed are graphs for the years 1966, 1968, 1969, 1970, and 1971.

If we can be of any further assistance please do not hesitate to call on us.

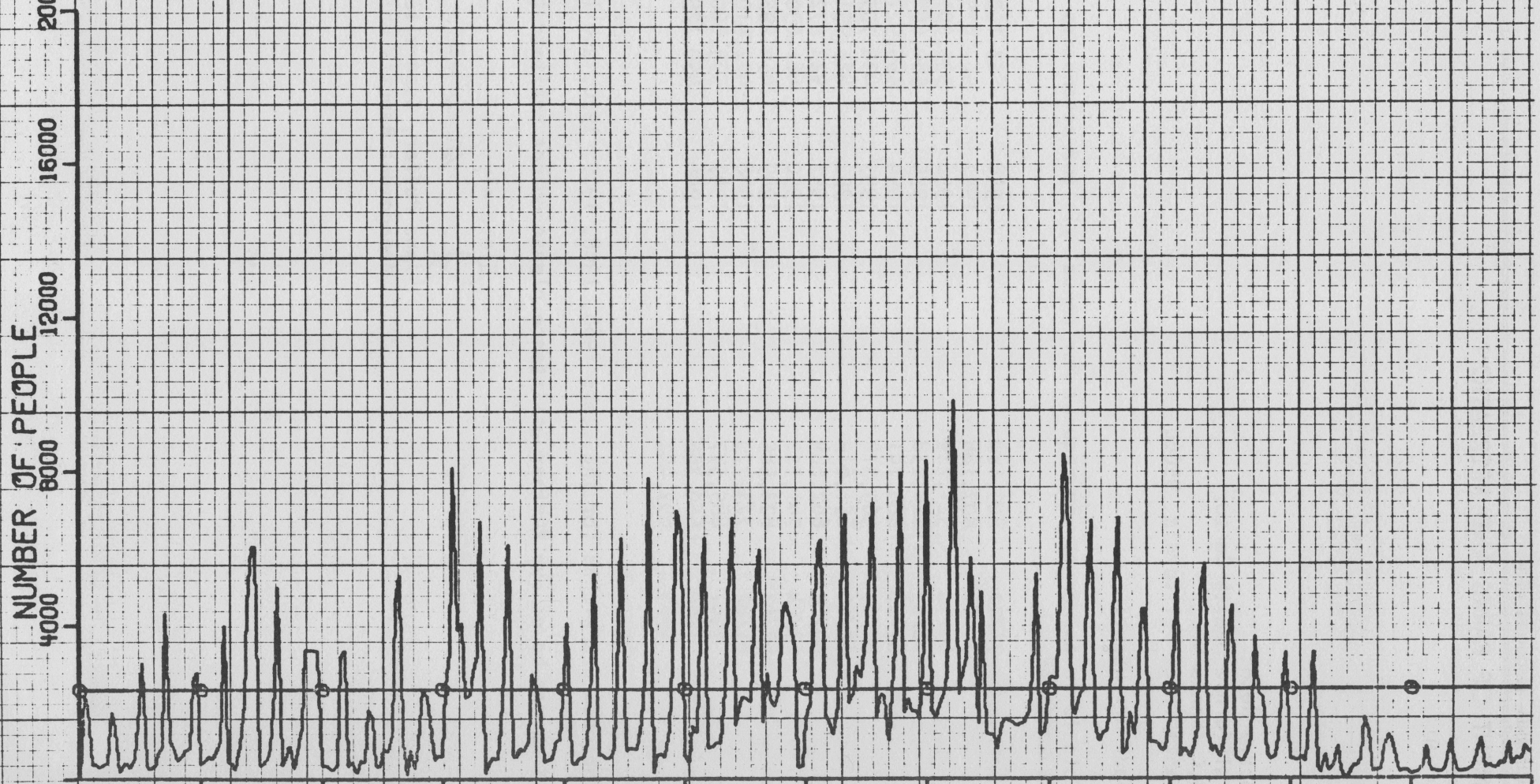
Sincerely,

Jane Puffer, Supervisor
Management Reports Unit

406

BIG BASIN REDWOODS STATE PARK

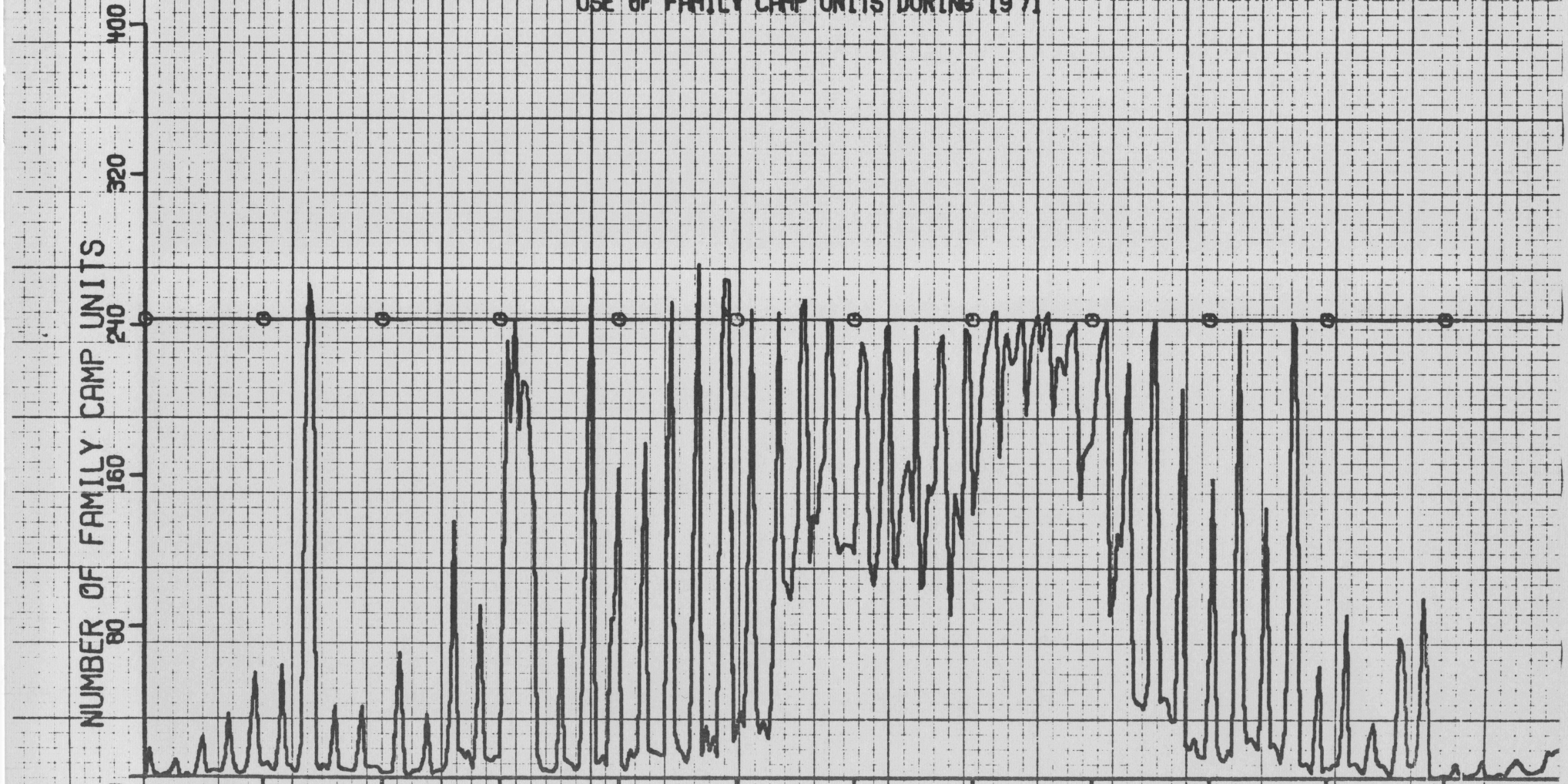
USE OF DAY USE FACILITIES DURING 1971



Source: California Dept of Parks and Recreation

BIG BASIN REDWOODS STATE PARK

USE OF FAMILY CAMP UNITS DURING 1971



SOURCE: California Dept. of Parks & Recreation

TOPICS FOR FURTHER RESEARCH

A number of questions or ideas for research came up several times during the course of the study. We feel they merit investigation, to better understand the changing landscape of the Waddell.

I. Earth

A. Bedrock geology

1. Research the structure and stratigraphy of the Butano sandstone, trying to determine its environment of deposition and origin of the sediments. This has significance for reconstructing pre- and early-San Andreas tectonism in California.

2. Map bedrock geology of the Last Chance community area, specifically section 19 T9SR3W, and Section 24, T9SE4W. This will aid in defining the limits of unstable earth in the area.

B. Quaternary geology

1. Work with the Soil Conservation Service in reconstructing floodplain geomorphology on the valley floor. This will help in reconstructing flood patterns.

2. Investigate valley terraces, particularly the "12-foot" terrace which appears to be widespread north of the Ben Lomond Fault.

3. Study and map slope processes across the Fault, particularly on the north slopes of Mt. McAbee and Pine Mountain. Slumps, slides, creep, rockfalls and other processes are apparent.

C. Man-influenced geology

1. A general reconnaissance and catalog of man-induced erosion and deposition is needed.

2. Study and estimate annual increments of silt in the upper reaches of the marsh; this is vital to its management.

II. Water

A. Inflow

1. Chart local variations in rainfall especially in the central third of the basin where currently there are no stations.

2. Investigate the effects of summer fog, particularly in the Monterey pine forest and the Chalks.

B. Transfer

1. Trace migration and storage of soil moisture along the Chalk slopes.

2. Record annual variations in storage and sedimentation in local reservoirs.

C. Outflow

1. Compare infiltrability of different soil types during storms.

2. Observe stream response to storms, aiming at construction of a storm hydrograph.

3. Continue water-quality sampling in a three-pronged program:
   a. regular sampling at representative and accessible locations
   b. grab sampling at remote locations in a manner similar to this year's program
   c. "impacted area" sampling--comparisons of disturbed areas against nearby central plots

III. Life

A. Studies of the effects of increased park use on wildlife

1. Initiate long term site-comparison study of the impact of park activities upon animal populations and community structure (e.g., redwood area near campsites versus redwood area not near campsites).
   Perhaps most conveniently done with birds. Long term study would involve repeated censusing of a given area.

2. Do a gradient study of same, to ascertain how animal populations and species diversity change with distance from the foci of human activity.

3. Make behavioral observations to determine in what ways the presence of man affects the feeding and general behavior of given animal species. Again, most easily carried out with birds or possibly insects.

B. Vegetational analysis

1. Analyse and contrast the forms of succession set in motion by:
   a. fire
   b. bulldozing
   c. slides
   d. logging
   e. flooding

2. Make a thorough study of succession and adaptation in the Chalks.

3. Consider a systematic study of Torreya and Garryea and their micro-environments. Torreya may be best studies in the drainage of the largest unnamed tributary to Henry Creek.

4. Begin a study of fresh-water marsh succession stemming from

siltation of the marsh.

C. Stream ecology

1. Make a comparative study of East and West Waddell Stream ecologies.
2. Research physical and biological aspects of steelhead spawning ground.

IV. Man's image of the land

A. Construct and implement a careful study of park users.

B. Attempt "recollection studies" of trail and outer-area users to determine what appeals to the weekend Waddell-er.

A blade of grass casts its shadow over the undulating "wood-grain" bedding in the Butano sandstone.

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Luckenbach, R.
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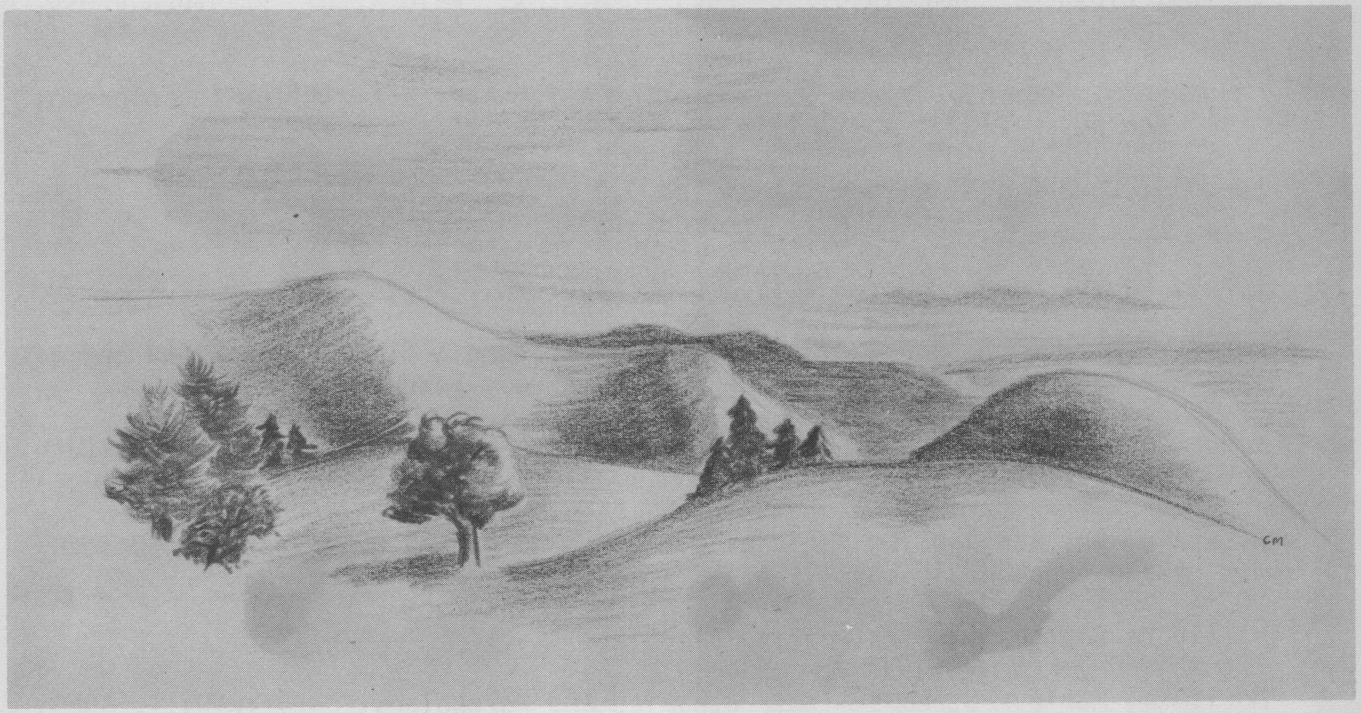

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Sandy Point
Guard Station
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BIG BASIN REDWOODS
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Berry Creek Falls
Berry Creek
Henry Creek
Waddell Creek
Lookout Chalk Mtn
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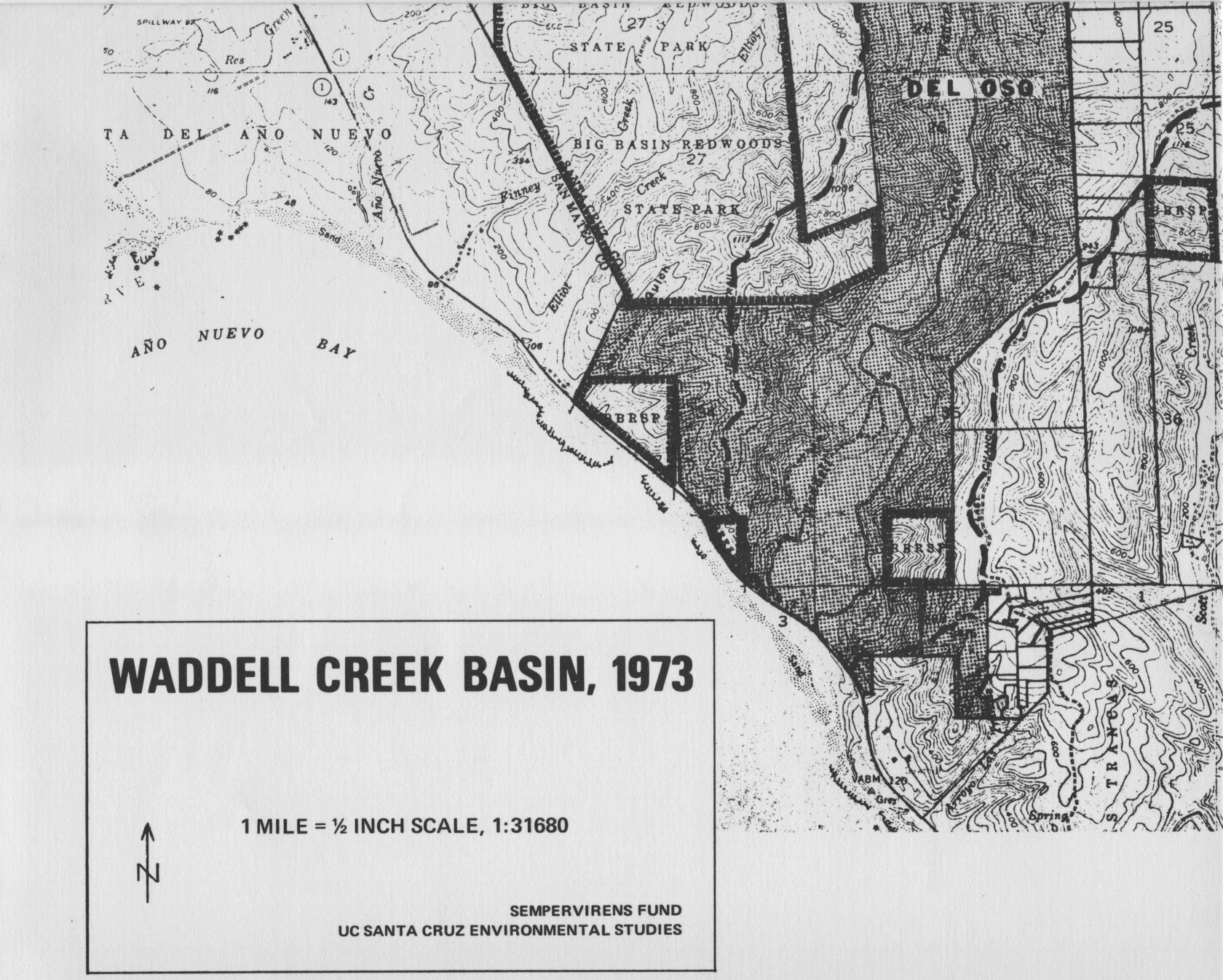

WADDELL CREEK BASIN, 1973

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UC SANTA CRUZ ENVIRONMENTAL STUDIES

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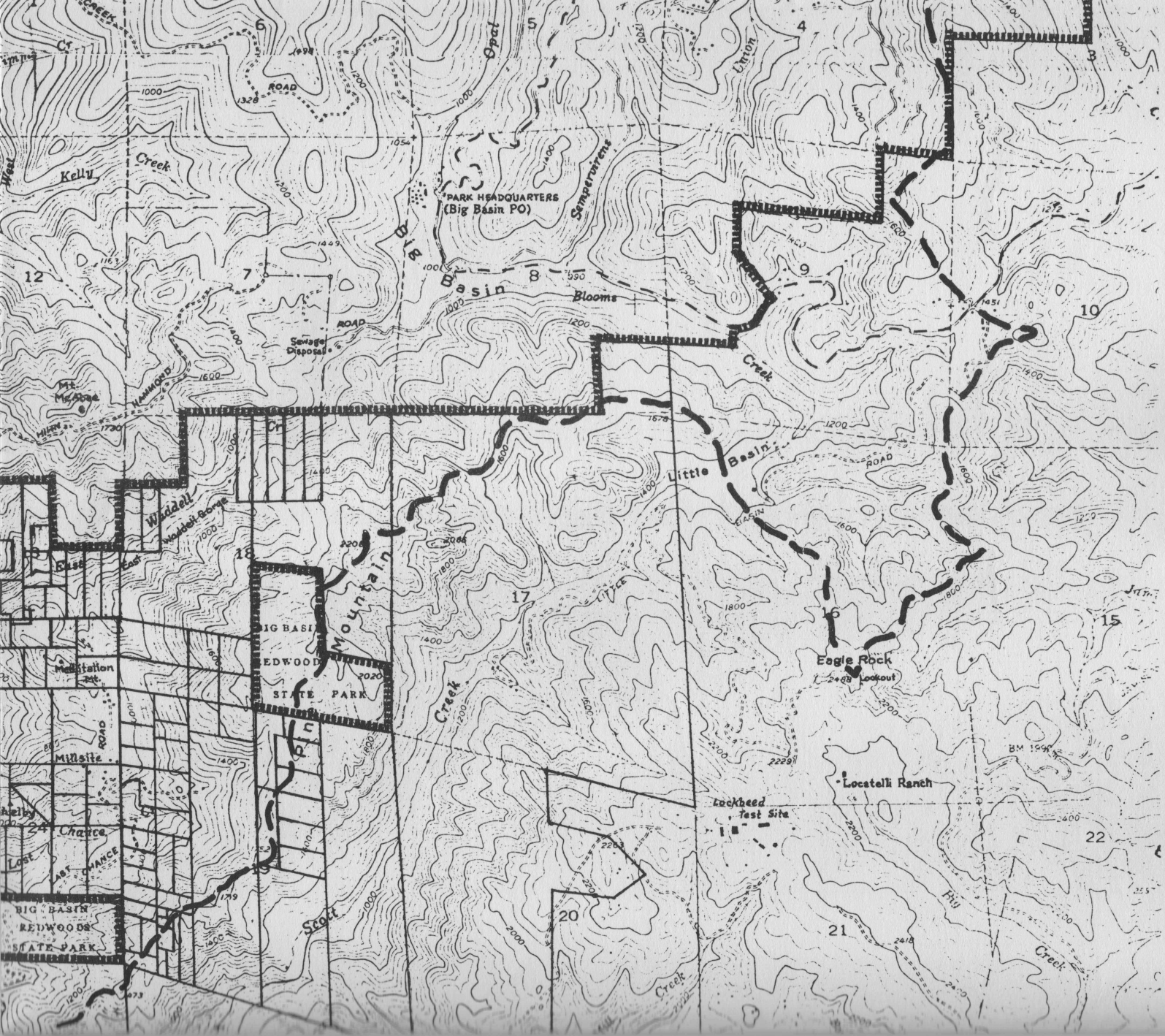
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Waddell Gorge
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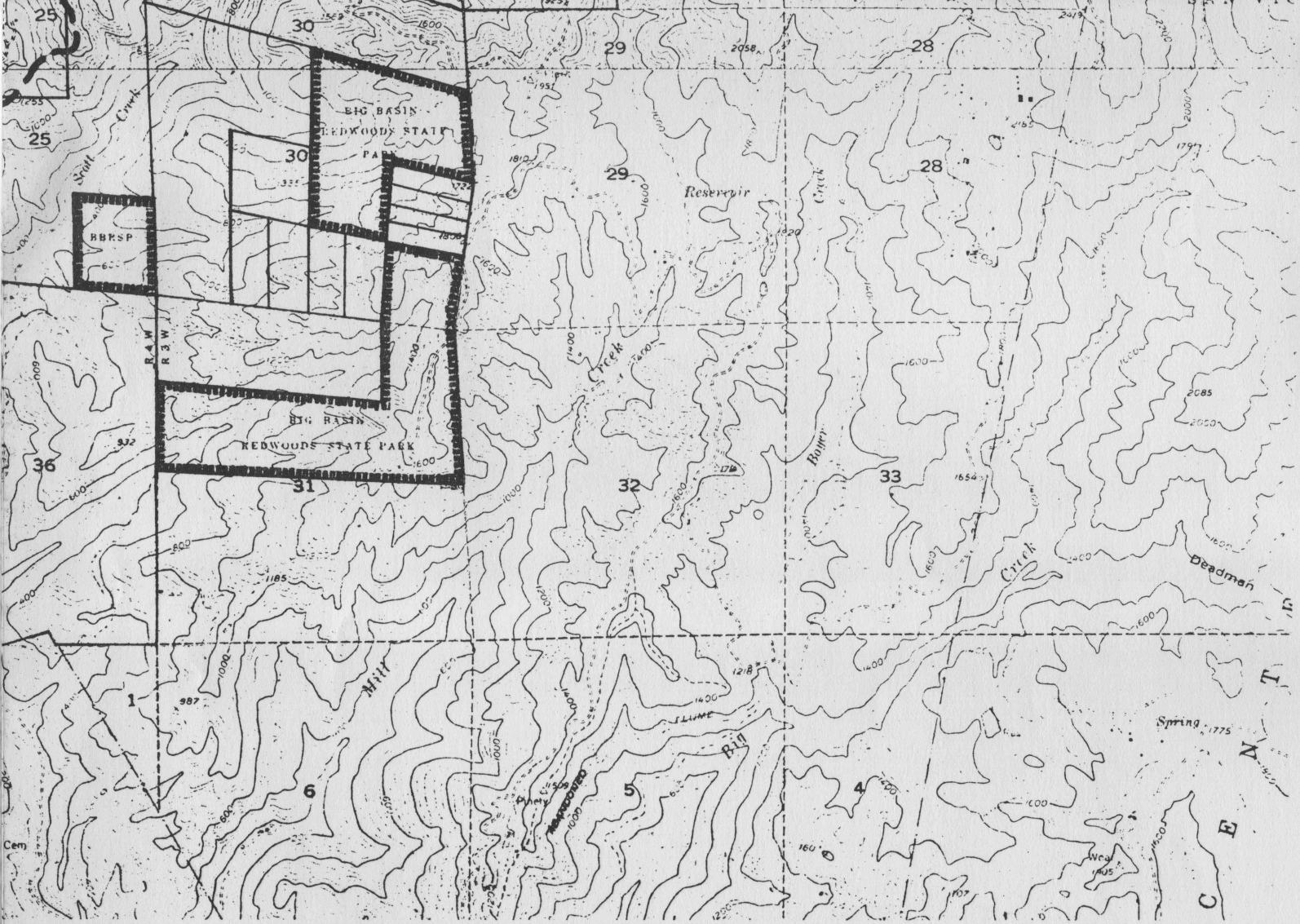

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Boyer
Creek
Deadman
Mill
Big
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JUN 1973